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ABSTRACT

This color-coded guide was developed to help teachers provide middle school and junior high students with an activity-oriented approach to learning and thinking about technology. Through the instruction and the activities, students are shown how the different systems interrelate, how they influence everyday life, and how they combine in a technological society. The guide contains 19 units, each of which includes some or all of the following basic components: objectives, suggested activities for the teacher, transparency masters, information sheets, assignment sheets, assignment sheet answers, laboratory activity sheets, written test, and answers to written test. Units cover the following topics: overview of technology; people, technology, and the environment; introduction to communication; designing, producing, transmitting, and evaluating messages; introduction to construction; designing, planning, building, and finishing a structure; introduction to manufacturing; manufacturing systems, materials, processes, planning, and production; introduction to energy; energy conversion and measurement; power transmission, control, and storage; and transportation system. (KC)

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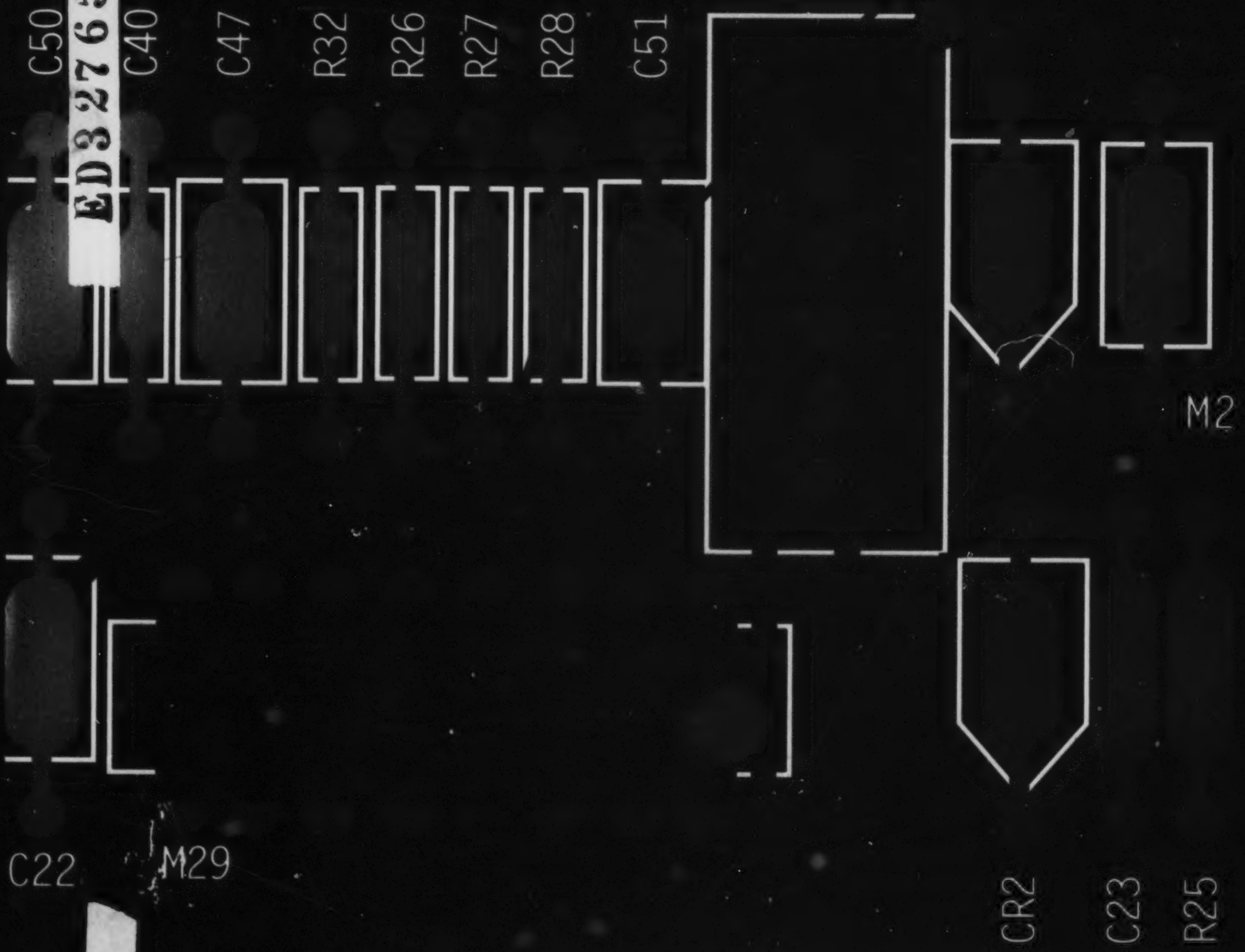

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2nd Edition
Teacher Guide

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# Exploring Technology Education

## Second Edition

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# *EXPLORING TECHNOLOGY EDUCATION*
## *◆◆ SECOND EDITION ◆◆*

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# FOREWORD

*Exploring Technology Education, 2nd Edition* was developed to provide middle school and junior high students with an activity-oriented approach to learning and thinking about technology. Through the instruction and the activities students will learn how the different systems interrelate, how they influence our lives every day, and how they combine to make our technological society.

MAVCC's *Exploring Technology Education, 2nd Edition* is a result of a cooperative effort between MAVCC and the Agency for Instructional Technology (AIT). AIT designed and produced nineteen video programs to complement MAVCC's nineteen units of instruction in this publication.

MAVCC's Technology Education Series consists of six publications. The series begins with *Exploring Technology Education* (Level I), which is followed by four Level II books that individually explore the technology systems. They are entitled *Exploring Construction, Exploring Communication, Exploring Manufacturing, and Exploring Energy, Power, and Transportation. Exploring Aeronautics and Space Technology* has been developed as a stand-alone publication or may be incorporated into each of the four technology systems.

This book, *Exploring Technology Education*, provides the foundation and serves as a building block for progressing into the study of the individual technology systems.

Every effort has been made to make this publication basic, readable, and by all means, usable. Three vital parts of instruction have been intentionally omitted from the publication: motivation, personalization, and localization. These areas are left to the individual instructors who should capitalize on them. Only then will these publications really become a vital part of the teaching-learning process

Jim Steward
Executive Director
Mid-America Vocational
Curriculum Consortium

Sylvia Clark, Chairwoman
Board of Directors
Mid-America Vocational
Curriculum Consortium

# ACKNOWLEDGEMENTS

Appreciation is extended to those individuals who contributed their time and talents in the development of *Exploring Technology Education, 2nd edition*.

The contents of this publication were reviewed by the following members of the Mid-America Vocational Curriculum Consortium technology education revision committee:

| | |
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Special appreciation is extended to the authors of the first edition: **Donovan Bowers, John Dugger,** and **Jimmie Wood**. Thanks are also given to the original committee who planned the MAVCC Technology Education Series.

Gratitude is expressed to the employees of the Graphics Division of the Oklahoma Department of Vocational-Technical Education for their assistance with the phototypesetting, artwork, pasteup, and printing of this text.

Thanks are also extended to **Mary Kellum**, MAVCC Curriculum Specialist, for her assistance with the editing of this book, as well as the coordination of the entire project.

# USE OF THIS PUBLICATION

## Instructional Units

*Exploring Technology Education* contains nineteen units of instruction. Each instructional unit includes some or all of the basic components of a unit of instruction; performance objectives, suggested activities for teachers and students, information sheets, transparency masters, assignment sheets, lab activity sheets, written tests, and answers to the assignment sheets and tests. Units are planned for more than one lesson or class period of instruction.

Careful study of each instructional unit by the teacher will help to determine:

A. The amount of material that can be covered in each class period.
B. The skills which must be demonstrated

    1. Supplies needed
    2. Equipment needed
    3. Amount of practice needed
    4. Amount of class time needed for demonstrations

C. Supplementary materials such as pamphlets or filmstrips that must be ordered
D. Resource people who must be contacted

## Objectives

Each unit of instruction is based on performance objectives. These objectives state the goals of the course, thus providing a sense of direction and accomplishment for the student.

Performance objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction; and specific objectives, stating the student performance necessary to reach the unit objective.

Since the objectives of the unit provide direction for the teaching-learning process, it is important for the teacher and students to have a common understanding of the intent of the objectives. A limited number of performance terms have been used in the objectives for this curriculum to assist in promoting the effectiveness of the communication among all individuals using the materials.

Reading of the objectives by the student should be followed by a class discussion to answer any questions concerning performance requirements for each instructional unit.

Teachers should feel free to add objectives which will fit the material to the needs of the students and community. When teachers add objectives, they should remember to supply the needed information, assignment and/or job sheets, and criterion tests.

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## Suggested Activities for the Instructor

Each unit of instruction has a suggested activities sheet outlining steps to follow in accomplishing specific objectives. Duties of instructors will vary according to the particular unit; however, for best use of the material they should include the following: provide students with objective sheet, information sheet, assignment sheets, and job sheets; preview filmstrips, make transparencies, and arrange for resource materials and people; discuss unit and specific objectives and information sheet; give test. Teachers are encouraged to use any additional instructional activities and teaching methods to aid students in accomplishing the objectives.

## Transparency Masters

Transparency masters provide information in a special way. The students may see as well as hear the material being presented, thus reinforcing the learning process. Transparencies may present new information or they may reinforce information presented in the information sheets. They are particularly effective when identification is necessary.

Transparencies should be made and placed in the notebook where they will be immediately available for use. Transparencies direct the class's attention to the topic of discussion. They should be left on the screen only when topics shown are under discussion.

## Information Sheets

Information sheets provide content essential for meeting the cognitive (knowledge) objectives in the unit. The teacher will find that the information sheets serve as an excellent guide for presenting the background knowledge necessary to develop the skill specified in the unit objective.

Students should read the information sheets before the information is discussed in class. Students may take additional notes on the information sheets.

## Transparency Masters

Transparency masters provide information in a special way. The students may see as well as hear the material being presented, thus reinforcing the learning process. Transparencies may present new information or they may reinforce information presented in the information sheets. They are particularly effective when identification is necessary.

Transparencies should be made and placed in the notebook where they will be immediately available for use. Transparencies direct the class's attention to the topic of discussion. They should be left on the screen only when topics shown are under discussion.

## Assignment Sheets

Assignment sheets give direction to study and furnish practice for paper and pencil activities to develop the knowledge which is a necessary prerequisite to skill development. These may be given to the student for completion in class or used for homework assignments. Separate answer sheets are provided as needed. Evaluation criteria are included on the assignment sheets.

## Lab Activity Sheets

Lab activity sheets provide a hands-on opportunity to apply concepts presented in the unit's information sheet. Needed tools and materials are listed and the procedure is written so students can follow it step-by-step. Evaluation criteria are also included on the lab activity sheets.

## Written Test

Paper-pencil and performance tests have been constructed to measure student achievement of each objective listed in the unit of instruction. Individual test items may be pulled out and used as a short test to determine student achievement of a particular objective. This kind of testing may be used as a daily quiz and will help the teacher spot difficulties being encountered by students in their efforts to accomplish the unit objective. Test items for objectives added by the teacher should be constructed and added to the test.

## Answers to Test

Test answers are provided for each unit. These may be used by the teacher and/or student for checking student achievement of the objectives.

# *EXPLORING TECHNOLOGY EDUCATION—SECOND EDITION*

## COMPETENCY PROFILE

Name: ____________________________________________

Directions: Evaluate the student using the rating scale below. Write the appropriate number to indicate the degree of competency achieved. The written test scoreline is provided for optional teacher use.

Rating Scale:
4—Skilled
3—Moderately Skilled
2—Limited Skill
1—Unskilled
0—No Exposure

### UNIT A-1: OVERVIEW OF TECHNOLOGY

______1. Identify examples of the four systems of technology in your community.
______2. Discuss the interrelationship between the four technology systems.
______3. Solve a problem as an individual or as a group.
______4. Construct a device that will solve a given problem according to stated rules.
______5. Construct a device that can compete in a race according to stated rules.
______6.
______ Written test score

### UNIT A-2: PEOPLE, TECHNOLOGY, AND THE ENVIRONMENT

______1. Complete a parent communique about safety.
______2. Survey the laboratory and identify correct safety practices.
______3. Identify safety violations.
______4. Complete a household waste inventory sheet.
______5.
______ Written test score

### UNIT B-1: INTRODUCTION TO COMMUNICATION

______1. Research a communication device and discuss its future.
______2. Research a communication career.
______3. Send a message in a unique manner.
______4. Establish a communication organization to produce a product or service.
______5. Develop a telephone simulator.
______6.
______ Written test score

**UNIT B-2: DESIGNING MESSAGES**

______1. Identify elements and principles of design.

______2. Improve an advertisement.

______3. Design a message.

______4. Sketch objects.

______5.

______ Written test score

**UNIT B-3: PRODUCING AND TRANSMITTING MESSAGES**

______1. Read units of measurement.

______2. Make a three-view sketch.

______3. Complete multiview drawings.

______4. Produce and transmit a visual message.

______5. Produce and transmit an audio or audiovisual message.

______6. Construct and demonstrate a fiberoptic simulator.

______7.

______ Written test score

**UNIT B-4: EVALUATING MESSAGES**

______1. Evaluate the communication organization.

______2.

______ Written test score

**UNIT C-1: INTRODUCTION TO CONSTRUCTION**

______1. Identify the major types of construction in your community.

______2. Research a construction technology career.

______3.

______ Written test score

**UNIT C-2: DESIGNING AND PLANNING A STRUCTURE**

______1. Calculate quantities of construction materials.

______2. Read a working drawing and calculate construction quantities and cost.

______3. Design a model truss bridge.

______4. Design a garden/utility shed.

______5. Design and construct a paper tower according to stated rules.

______

______ Written test score

**UNIT C-3: BUILDING A STRUCTURE**

______1. Construct a model truss bridge.

______2. Construct a garden/utility shed.

______3.

______ Written test score

**UNIT C-4: FINISHING A STRUCTURE**

______1. Finish the garden/utility shed.

______2. Inspect the garden/utility shed.

______3.

______ Written test score

**UNIT D-1: INTRODUCTION TO MANUFACTURING**

______1. Research and write about an inventor or invention that contributed to the Industrial Revolution.

______2. Describe societal needs that the manufacturing industry has addressed during the last two centuries.

______3. Research a manufacturing technology career.

______4. Organize a classroom manufacturing company.

______5. Participate in an assembly-line activity.

______6.

______ Written test score

**UNIT D-2: MANUFACTURING SYSTEMS**

______1. Identify and gather information about two businesses in your community.

______2. Determine ways to obtain capital resources for a class manufacturing company.

______3. Write a resume.

______4. Complete a job application for the class manufacturing company.

______5. Interview for a job in the class manufacturing company.

______6.

______7. Written test score

**UNIT D-3: MANUFACTURING MATERIALS**

______1. Test various properties of two samples of wood and record the results.

______2. Identify a product that can be manufactured by your class company.

______3. Sketch three views of the product selected by class for production.

______4. Select materials needed for production of class product.

______5. Construct and test a cellular structure.

______6.

______ Written test score

**UNIT D-4: MANUFACTURING PROCESSES**

______1. Identify the manufacturing processes needed to make class manufacturing company's product.

______2. Identify tools and machines needed to make class manufacturing company's product.

______3. Subscribe to a safety pledge.

______4.

______ Written test score

**UNIT D-5: MANUFACTURING PLANNING AND PRODUCTION**

______1. Prepare a flow process chart for the class manufacturing company's product.

______2. Participate in production of the class manufacturing company's product.

______3. Market the class manufacturing company's product.

______4. Evaluate the class manufacturing company's product.

______5. Evaluate the class manufacturing company by division.

______6.

______ Written test score

**UNIT E-1: INTRODUCTION TO ENERGY**

______1. Compare energy sources.

______2. Determine present personal energy needs and predict their sources if there were no fossil fuels.

______3. Research and report on a career in energy, power, and transportation.

______4.

______ Written test score

**UNIT E-2: ENERGY CONVERSION AND MEASUREMENT**

______1. Identify energy conversions.

______2. Solve problems involving energy and power measurements.

______3. Construct an electrical conversion simulator.

______4. Construct a thermal conversion simulator.

______5.

______ Written test score

**UNIT E-3: POWER TRANSMISSION, CONTROL, AND STORAGE**

______1. Determine mechanical advantage of simple machines.

______2. Calculate velocity and miles per hour.

______3. Design a model racer.

______4. Build a model racer.

______5.

______ Written test score

**UNIT E-4: TRANSPORTATION SYSTEMS**

______1. Solve gas mileage problems.

______2. Classify cargo and services transported to your community.

______3. Design and build a model transportation vehicle or system.

______4.

______ Written test score

**COMMENTS:** ________________________________________________

Permission to duplicate this profile is granted.

# *EXPLORING TECHNOLOGY EDUCATION*
*♦♦ Second Edition ♦♦*

## INSTRUCTIONAL / TASK ANALYSIS

## SECTION A: INTRODUCTION

### UNIT A-I: OVERVIEW OF TECHNOLOGY

| RELATED INFORMATION: What the Student Should Know (Cognitive) | PRACTICAL APPLICATION: What the Student Should Be Able to Do (Psychomotor) |
|---|---|
| 1. Terms and definitions | |
| 2. Science and technology | |
| 3. Parts of the systems model | |
| 4. Four systems of technology | |
| 5. How the four systems of technology interrelate | |
| 6. Resources used by technology | |
| 7. Historical changes in technology | |
| 8. Examples of types of American industries | |
| 9. Steps in problem-solving | |
| 10. Techniques used in problem-solving | |
| | 11. Identify examples of the four systems of technology in your community. |
| | 12. Discuss the interrelationship between the four technology systems. |
| | 13. Solve a problem as an individual or as a group. |
| | 14. Construct a device that will solve a given problem according to stated rules. |
| | 15. Construct a device that can compete in a race according to stated rules. |

| RELATED INFORMATION: What the Student Should Know (Cognitive) | PRACTICAL APPLICATION: What the Student Should Be Able to Do (Psychomotor) |
|---|---|

## UNIT A-2: PEOPLE, TECHNOLOGY, AND THE ENVIRONMENT

1. Terms and definitions
2. Interrelationship between people, technology, and the environment
3. Types of environmental pollution
4. Environmental conservation activities
5. Recyclables and nonrecyclables
6. General laboratory safety rules
7. Personal safety rules
8. Futuring techniques
9. Complete a parent communique about safety.
10. Survey the laboratory and identify correct safety practices.
11. Identify safety violations.
12. Complete a household waste inventory sheet.

## ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆SECTION B: COMMUNICATION◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆

## UNIT B-1: INTRODUCTION TO COMMUNICATION

1. Terms and definitions
2. Eras of history and corresponding communication inventions
3. Purposes of communication
4. Elements of communication
5. Steps in the communication process
6. Parts of the communication system model
7. Ways to communicate
8. Types of communication

| RELATED INFORMATION: What the Student Should Know (Cognitive) | PRACTICAL APPLICATION: What the Student Should Be Able to Do (Psychomotor) |
|---|---|
| 9. Impact of communication technology | |
| 10. Interrelationships between communication and the other technology systems | |
| 11. Careers in communication | |
| | 12. Research a communication device and discuss its future. |
| | 13. Research a communication career. |
| | 14. Send a message in a unique manner. |
| | 15. Establish a communication organization to produce a product or service. |
| | 16. Develop a telephone simulator. |

## UNIT B-2: DESIGNING MESSAGES

| | |
|---|---|
| 1. Terms and definitions | |
| 2. Steps in designing a message | |
| 3. Ways to design preliminary messages | |
| 4. Elements of visual design | |
| 5. Principles of visual design | |
| 6. Types of sketches | |
| 7. Purposes of sketching | |
| 8. Steps in sketching | |
| 9. Methods for audio and audiovisual designing | |
| | 10. Identify elements and principles of design. |
| | 11. Improve an advertisement. |

| RELATED INFORMATION: What the Student Should Know (Cognitive) | PRACTICAL APPLICATION: What the Student Should Be Able to Do (Psychomotor) |
|---|---|
| | 12. Design a message. |
| | 13. Sketch objects. |

## UNIT B-3: PRODUCING AND TRANSMITTING MESSAGES

1. Terms and definitions
2. Methods of producing and transmitting visual messages
3. Methods of producing and transmitting audio and audiovisual messages
4. Emerging communication transmission technologies
5. Basic drafting tools and equipment
6. Systems of measurement
7. Multiview drawing
8. Read units of measurement.
9. Make a three-view sketch.
10. Complete multiview drawings.
11. Produce and transmit a visual message.
12. Produce and transmit an audio or audiovisual message.
13. Construct and demonstrate a fiberoptic simulator.

## UNIT B-4: EVALUATING MESSAGES

1. Terms and definitions
2. Parts of a message to evaluate
3. Importance of feedback

RELATED INFORMATION: What the Student Should Know (Cognitive)

PRACTICAL APPLICATION: What the Student Should Be Able to Do (Psychomotor)

4. Forms of feedback

5. Examples of feedback

6. Evaluate the communication organization.

## SECTION C: CONSTRUCTION

### UNIT C-1: INTRODUCTION TO CONSTRUCTION

1. Terms and definitions

2. Major types of construction

3. Purposes of construction

4. Parts of the construction system model

5. Interrelationship between construction and the other technology systems

6. Advantages and disadvantages of construction

7. Construction technology careers

8. Identify the major types of construction in your community.

9. Research a construction technology career.

### UNIT C-2: DESIGNING AND PLANNING A STRUCTURE

1. Terms and definitions

2. Steps in designing and planning a structure

3. Types of working drawings used in construction

4. Main parts of a working drawing

5. Basic types of lines used on working drawings

| RELATED INFORMATION: What the Student Should Know (Cognitive) | PRACTICAL APPLICATION: What the Student Should Be Able to Do (Psychomotor) |
|---|---|
| 6. Materials commonly used in construction | |
| 7. Formulas for measuring construction materials | |
| 8. Information on a bill of materials | |
| | 9. Calculate quantities of construction materials. |
| | 10. Read a working drawing and calculate construction quantities and cost. |
| | 11. Design a model truss bridge. |
| | 12. Design a garden/utility shed. |
| | 13. Design and construct a paper tower according to stated rules. |

## UNIT C-3: BUILDING A STRUCTURE

1. Terms and definitions
2. Steps in building a structure
3. Methods for clearing a site
4. Types of concrete footings and foundations
5. Parts of a floor frame
6. Parts of a wall frame
7. Parts of a roof frame
8. Parts of a wall section
9. Common mechanical systems used in construction
10. Basic tools and equipment used in construction
11. Precautions to follow in the safe use of construction tools
12. Personal safety rules
13. Lab safety rules

RELATED INFORMATION: What the Student Should Know (Cognitive)

PRACTICAL APPLICATION: What the Student Should Be Able to Do (Psychomotor)

14. Construct a model truss bridge.
15. Construct a garden/utility shed.

### UNIT C-4: FINISHING A STRUCTURE

1. Terms and definitions
2. Steps in finishing a structure
3. Purposes of finish work
4. Exterior finishing
5. Types of insulation used in a structure
6. Interior finishing
7. Parts of mechanical systems installed as finish work
8. Steps in landscaping
9. Ways to conserve energy in construction
10. Finish the garden/utility shed.
11. Inspect the garden/utility shed.

## SECTION D: MANUFACTURING

### UNIT D-1: INTRODUCTION TO MANUFACTURING

1. Terms and definitions
2. Historical perspective of manufacturing
3. Advantages and disadvantages of manufacturing
4. Interrelationship between manufacturing and other technologies
5. Parts of a manufacturing system model

| RELATED INFORMATION: What the Student Should Know (Cognitive) | PRACTICAL APPLICATION: What the Student Should Be Able to Do (Psychomotor) |
|---|---|
| 6. Divisions of a manufacturing organization and their functions | |
| 7. Manufacturing divisions and job titles | |
| | 8. Research and write about an inventor or invention that contributed to the Industrial Revolution. |
| | 9. Describe societal needs that the manufacturing industry has addressed during the last two centuries. |
| | 10. Research a manufacturing technology career. |
| | 11. Organize a classroom manufacturing company. |
| | 12. Participate in an assembly-line activity. |

## UNIT D-2: MANUFACTURING SYSTEMS

1. Terms and definitions
2. Types of manufacturing systems
3. Types of automated manufacturing
4. Criteria used in choosing an appropriate type of manufacturing system
5. Items needed by a manufacturing enterprise
6. Functions of management
7. Responsibilities of management
8. Forms of ownership of manufacturing enterprises
9. Importance of different forms of ownership in the U.S.

| RELATED INFORMATION: What the Student Should Know (Cognitive) | PRACTICAL APPLICATION: What the Student Should Be Able to Do (Psychomotor) |
|---|---|
| 10. Methods of obtaining capital resources | |
| 11. Attributes that an employer looks for in an employee | |
| | 12. Identify and gather information about two businesses in your community |
| | 13. Determine ways to obtain capital resources for a class manufacturing company |
| | 14. Write a resume |
| | 15. Complete a job application for the class manufacturing company |
| | 16. Interview for a job in the class manufacturing company |

## UNIT D-3: MANUFACTURING MATERIALS

1. Common manufacturing materials
2. Major types of woods
3. Characteristics of woods
4. Types of metals
5. Properties of metals
6. Types of plastics
7. Properties of plastics
8. Types of earth materials
9. Properties of earth materials
10. Types of composites
11. General properties of materials
12. Considerations when selecting a material

RELATED INFORMATION: What the Student Should Know (Cognitive)

PRACTICAL APPLICATION: What the Student Should Be Able to Do (Psychomotor)

13. Test various properties of two samples of wood and record the results.
14. Identify a product that can be manufactured by your class company.
15. Sketch three views of the product selected by class for production.
16. Select materials needed for production of class product.
17. Construct and test a cellular structure.

## UNIT D-4: MANUFACTURING PROCESSES

1. Terms and definitions
2. Pre-processing, processing, and post-processing operations
3. Primary and secondary manufacturing processes
4. Major types of separating processes
5. Elements of the forming process
6. Steps in the casting process
7. Types of conditioning processes
8. Assembly processes
9. Major finishing operations
10. General safety rules
11. Identify the manufacturing processes needed to make class manufacturing company's product.
12. Identify tools and machines needed to make class manufacturing company's product.
13. Subscribe to a safety pledge.

RELATED INFORMATION: What
the Student Should Know
(Cognitive)

PRACTICAL APPLICATION: What
the Student Should Be Able to Do
(Psychomotor)

## UNIT D-5: MANUFACTURING PLANNING AND PRODUCTION

1. Terms and definitions
2. Key principles of mass production
3. Steps in production
4. Responsibilities of production planning and control
5. Responsibilities of industrial engineering
6. Considerations in plant layout
7. Characteristics of a flow process chart
8. Flow chart symbols
9. Responsibilities of quality control
10. Key activities of marketing
11. Prepare a flow process chart for the class manufacturing company's product.
12. Participate in production of the class manufacturing company's product.
13. Market the class manufacturing company's product.
14. Evaluate the class manufacturing company's product.
15. Evaluate the class manufacturing company by division.

## ♦♦♦♦♦♦♦♦SECTION E: ENERGY, POWER, AND TRANSPORTATION♦♦♦♦♦♦♦♦

## UNIT E-1: INTRODUCTION TO ENERGY

1. Terms and definitions
2. Classifications of energy

| RELATED INFORMATION: What the Student Should Know (Cognitive) | PRACTICAL APPLICATION: What the Student Should Be Able to Do (Psychomotor) |
|---|---|
| 3. Sources of energy | |
| 4. Past, present, and future uses of energy sources | |
| 5. Economic and environmental effects of energy | |
| 6. Parts of the energy, power, and transportation system model | |
| 7. Goals of energy conservation | |
| 8. Ways to conserve energy | |
| 9. Careers and educational requirements for energy areas | |
| | 10. Compare energy sources. |
| | 11. Determine present personal energy needs and predict their sources if there were no fossil fuels. |
| | 12. Research and report on a career in energy, power, and transportation. |

### UNIT E-2: ENERGY CONVERSION AND MEASUREMENT

| | |
|---|---|
| 1. Terms and definitions | |
| 2. Categories of energy | |
| 3. Forms of energy | |
| 4. Characteristics of energy | |
| 5. Types of conversions | |
| 6. Measurement of energy and power | |
| | 7. Identify energy conversions. |
| | 8. Solve problems involving energy and power measurements. |
| | 9. Construct an electrical conversion simulator |
| | 10. Construct a thermal conversion simulator |

**RELATED INFORMATION: What the Student Should Know (Cognitive)**

**PRACTICAL APPLICATION: What the Student Should Be Able to Do (Psychomotor)**

## UNIT E-3: POWER TRANSMISSION, CONTROL, AND STORAGE

1. Terms and definitions
2. Types of power systems
3. Types of fluid power systems
4. Electrical power system devices
5. Examples of thermal power systems
6. Types of motion
7. Types of simple machines for transmitting mechanical power
8. Functions of machines
9. Types of drives for transmitting and controlling mechanical power
10. Storing potential and kinetic energy
11. Determine mechanical advantage of simple machines
12. Calculate velocity and miles per hour
13. Design a model racer
14. Build a model racer

## UNIT E-4: TRANSPORTATION SYSTEMS

1. Terms and definitions
2. Purposes of transportation
3. Components of a transportation system
4. Basic modes of transportation
5. Highway transportation
6. Railway transportation
7. Pipeline transportation
8. Types of on-site transportation

**RELATED INFORMATION: What the Student Should Know (Cognitive)**

9. Water transportation
10. Air transportation
11. Space transportation

**PRACTICAL APPLICATION: What the Student Should Be Able to Do (Psychomotor)**

12. Solve gas mileage problems
13. Classify cargo and services transported to your community
14. Design and build a model transportation vehicle or system

# *EXPLORING TECHNOLOGY EDUCATION*

## TOOLS, MATERIALS, AND EQUIPMENT LIST

### Section A—Introduction

Candle
Mousetraps
Scrap pieces of wood for mousetrap vehicle

### Section B—Communication

Basic drafting tools—T-square or parallel bar, triangles, protractor, compass, scales, pencils, erasers
Drafting media—Vellum, film, sketching paper
Computer-aided design and drafting (CADD) system
Equipment for transmitting messages including audio/audiovisual equipment, photography equipment and supplies, desktop publishing system and supplies, and/or printing equipment and supplies
Tools and materials for telephone simulator including tin cans, copper wire, finish nails, and hammer
Tools and materials for fiberoptic simulator including clear acrylic rod, electrical tape, flashlight, drill press, band saw, and safety equipment

### Section C—Construction

Manual or computer-aided drafting tools, materials, and equipment for designing structures
Materials for constructing a paper tower including paper, tape, ruler, and scissors
Basic tools and supplies for building a model truss bridge including basswood (balsa), white glue, straight pins, ruler, and bridge stress tester
Basic tools and equipment for building a garden/utility shed including hand tools such as hammers, saws, wrenches, tape measures, levels, squares, and screwdrivers; power tools such as jig saws, table saws, circular saws, nailers, drills, and staplers; and light equipment such as ladders, sawhorses, and wheelbarrows
Materials for building a garden/utility shed including framing lumber (2x4s), plywood sheathing, tar paper, box nails, and treated lumber for skids
Materials for exterior and interior finishing of garden/utility shed including shingles, siding, paint, drywall, insulation, etc.

### Section D—Manufacturing

Materials to be packaged for assembly-line activity
Wood samples for testing
Manual or computer-aided drafting tools, materials, and equipment for designing products to be manufactured by class
Materials for constructing and testing a cellular structure including paper, adhesive tape, ruler, ink pens, scissors, weights, and scales
Hand and power tools and equipment needed to manufacture class product including drills, routers, saw, grinders, forms, casts, fasteners, and finishers
Raw or stock materials needed to manufacture class product including lumber, plastics, paints, stains, etc.
Safety equipment
Materials for marketing class product (paper, posters, paints, etc.)

## Section E—Energy, Power, and Transportation

Tools and materials for constructing an electrical conversion simulator including electric motors, multimeter, 1.5 and 6 volt batteries, 6 volt LED, hot glue system, wires, plastic tube, and wood block

Tools and materials for constructing a thermal conversion simulator including electric motor, drill, drill bit, aluminum roof flashing, 1.5 volt LED, hot glue system, hot plate burner, straw, band or scroll saw, wires, beaker and stopper, rubber hose, wood blocks, welding or dowel rod, metal pan, and plastic tube

Manual or computer-aided drafting tools and equipment for designing a model racer

Tools and equipment for building a model racer including cabinet file, pliers, scratch awl, wood rasp, hand drill or drill press and bits, scroll, coping, or band saw, and C-clamps

Materials for building a model racer including wood block, carbon paper, pencil, masking tape, rubber bands, sandpaper, screw eyes, soda straws, washers, plastic wheels, and axles

Tools and materials for building a transportation vehicle (such as rocket, plane, boat, car, etc.) or system (such as conveyor or pipeline)

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## OVERVIEW OF TECHNOLOGY
## UNIT A-1

### UNIT OBJECTIVE

After completion of this unit, the student should be able to distinguish between the four systems of technology, discuss how they relate to industry, and utilize problem-solving techniques in relating the systems to society. Competencies will be demonstrated by completing the assignment sheets, lab activity sheets, and unit test with a minimum score of 85 percent.

### SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to technology with the correct definitions.
2. Distinguish between science and technology.
3. Identify the parts of the systems model.
4. Match the four systems of technology with the correct definitions.
5. Complete statements concerning how the four systems of technology interrelate.
6. Match the resources used by technology with the correct definitions.
7. Select true statements concerning historical changes in technology.
8. List examples of types of American industries.
9. Arrange in order the steps in problem-solving.
10. Discuss techniques used in problem-solving.
11. Identify examples of the four systems of technology in your community. (Assignment Sheet #1)
12. Discuss the interrelationship between the four technology systems. (Assignment Sheet #2)
13. Solve a problem as an individual or as a group. (Assignment Sheet #3)
14. Construct a device that will solve a given problem according to stated rules. (Lab Activity Sheet #1)
15. Construct a device that can compete in a race according to stated rules. (Lab Activity Sheet #2)

## OVERVIEW OF TECHNOLOGY
## UNIT A-1

### SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher edition only and are designed to be used with the following objectives:

TM 1 — Systems Model — Objective 3
TM 2 — Systems of Technology — Objectives 4 and 5
TM 3 — Resources of Technology — Objective 6
TM 4 — Historical Changes in Technology — Objective 7
TM 5 — Steps in Problem Solving — Objective 9

(NOTE: Transparencies printed on acetate sheets are available as a set for this publication. This set may be purchased from your state curriculum lab or directly from MAVCC by writing to 1500 West Seventh, Stillwater, OK 74074-4364 or by calling toll free 1-800-654-3988.)

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. Use Teacher Supplement #1 to present AIT video A-1. This video was developed by the Agency for Instructional Technology (AIT) and a consortium of states to accompany this publication. Contact your state supervisor of technology education for copies, or contact AIT directly for more information:

   Agency for Instructional Technology (AIT)
   Box A, Bloomington, IN 47402
   800-457-4509 or 812-339-2203

2. Use Teacher Supplements #2 and #3 to help students understand this unit's terminology. Make copies (fronts only) for your students. The answers are on the backs of the supplements.

   (NOTE: These supplements have been developed for each unit and are designed to be used as an optional activity for your students. Although you may not want to use them in each unit, feel free to pick and choose as you feel is appropriate.)

## SUGGESTED ACTIVITIES

3. Perhaps the best method for teaching an introduction to technology is by using the systems approach. The systems model will be applied to all four areas covered in this course. This model includes four basic parts: input, process, output, and feedback. Any technological system can be analyzed by using the parts in this model.

4. Technology-based classroom and laboratory activities are a natural base from which to organize and conduct group activities. This can easily be done by initiating and organizing a student organization. A student organization can actually become a part of the course content and become a part of your technology curriculum. A student organization which relates well to technology education is the Technology Student Association (TSA). This organization is the official affiliate of the International Technology Education Association (ITEA).

5. TSA comprehensive guides and materials for forming a chapter may be obtained from the following:

   National TSA Headquarters
   1908 Association Drive
   Reston, VA 22091
   703-860-9000

6. TSA conferences are held at regional, state, and national levels. These professional conferences allow the students the opportunity to work and compete with students from other chapters. This atmosphere provides a learning and motivational experience. It is also helpful in developing leadership, problem-solving skills, and good work habits.

7. Alternative activities for Assignment Sheet #3 include:

   a. Plan a cross-country trip in present or future time.
   b. Plan a trip to the moon.
   c. Plan a trip to a desert island to live for a year.
   d. Plan a city.
   e. Design a subdivision.
   f. Create a communication network for the school.

   (NOTE: Assignment Sheet #3 and Lab Activity Sheets #1 and #2 are designed to promote creativity and develop problem-solving skills. There are many other activities which could be used to promote this.)

8. Discuss the needs of the family in the past, present, and future.

9. Show films introducing students to technology and technology education.

10. Discuss how technology has changed your life and the students' lives.

11. Discuss environmental problems caused by technology and present efforts to solve these problems. Also discuss possible future environmental problems and how they may be solved or hopefully prevented.

## SUGGESTED ACTIVITIES

12. Have students select a local company and discuss how they utilize the four systems of technology. Discuss the interdependence of the four systems.

13. Divide the class into four groups. Have each group select an object which represents one of the systems of technology.

    Examples: Automobile — Energy, power, and transportation
    Computer — Communication
    Office building — Construction
    Any mass-produced item — Manufacturing

    Have each group discuss how the other systems affect the production and use of their object. It is important for the students to appreciate and understand the interdependence of the four systems of technology.

14. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Administer test.

I. Evaluate test.

J. Reteach if necessary.

## REFERENCES USED IN DEVELOPING THIS UNIT

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H. *Introduction to Technology*, Grade 7. State of New York Education Department.

## SUGGESTED ACTIVITIES

I. Wright, R. Thomas, and Richard M. Henak. *Exploring Production.* South Holland, IL: The Goodheart-Willcox Company, Inc., 1985.

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L. Wright, R. Thomas and Howard Bud Smith. *Understanding Technology.* South Holland, IL: Goodheart-Willcox Company, Inc., 1989.

## SUGGESTED SUPPLEMENTAL RESOURCES

A. Visual aids (videotapes)

1. *You, Me, and Technology* Series (20 min. tapes). Available from:

   Delmar Publishers, Inc.
   2 Computer Drive, West
   Box 15015
   Albany, NY 12212
   800-347-7707

   a. *Living with Technology*
   b. *Decisions, Decisions, Decisions*
   c. *The Technology Spiral*
   d. *Energy for Societies*
   e. *Health and Technology*
   f. *Feeding the World*
   g. *Communications*
   h. *The Changing Romance*
   i. *China, Japan, and the West*
   j. *Population Patterns and Technology*
   k. *Exploring Space*
   l. *Risk, Safety, and Technology*
   m. *Instructor Guide*

2. *Connections*, a PBS series of videotapes. Available from:

   40 West 57th Street
   New York, NY 10019

   a. *The Trigger Effect*
   b. *Death in the Morning*
   c. *Wheel of Fortune*
   d. *Long Chain*
   e. *Eat, Drink, and Be Merry*
   f. *Countdown*

## SUGGESTED ACTIVITIES

g. *Yesterday, Tomorrow, and You*
h. *Faith in Numbers*
i. *Distant Voices*

3. *Overview of Technology*. ½" VHS. Color. 15 min. 1990. Available from:

Agency for Instructional Technology
Box A
Bloomington, Indiana 47402
800-457-4509

4. *Exploring Technology* series (five videotapes or filmstrips). Include the following:

a. *Historical Evolution*
b. *Required Resources*
c. *The Universal Systems Model*
d. *Controlling Systems*
e. *Determining Impacts*

These are available from:

Bergwall Productions, Inc.
P.O. Box 238
Garden City, NY 11530-0238
800-645-3565

5. *Effective Thinking: Ways of Problem Solving*, #00294-124 (slides-on-video)

6. *Decision-Making Skills*, #06720-124 (filmstrips-on-video)

5 and 6 are available from:

The Center for Humanities
Communications Park, Box 1000
Mount Kisco, NY 10549
800-431-1242

7. *Imagineering*, #4881 M. 19 min. Video. Creative strategies for generating new ideas. Astronaut Alan Shepard discusses brainstorming and other cooperative techniques. Available from:

Coronet/MTI Film and Video
108 Wilmot Road
Deerfield, IL 60015
800-621-2131

## SUGGESTED ACTIVITIES

B. Journals and magazines

(NOTE: The following is a list of publications which are recommended for technology education instructors who wish to stay current with the latest technology developments.)

1. *Popular Science*
2. *Popular Mechanics*
3. *Motor*
4. *School Shop*
5. *Industrial Education*
6. *The Journal (Technology Horizons in Education)*
7. *The Technology Teacher*
8. *Journal of Epsilon Pi Tau*
9. *Modern Photography*
10. *Robotics Age*
11. *Solar Energy*
12. *Home Mechanics*
13. *Manufacturing Forum* (Ball State University, Muncie, Ind.)
14. *NASA Technology Briefs*
15. *TIES Magazine*
16. *Aviation Week and Space Technology*
17. *Autoweek*

(NOTE: There are many other periodicals that could be added to this list.)

C. Software

1. A variety of software is available from public domain software vendors. These vendors can be found in almost any computer magazine. Examples of software include flight simulators, driving simulators, CAD programs, word processors, clip art, desktop publishers, and educational programs (gradebook).

    a. A vendor for IBM public domain software is:

    Public Brand Software
    P.O. Box 51315
    Indianapolis, IN 46251
    800-426-3475

    b. Apple and IBM software:

    Technology Education Software Bank
    The Ohio State University
    190 West 19th Street
    Columbus, OH 43210
    614-422-7471

    (NOTE: Public domain software is not copyrighted and copies can be made freely. Most vendors provide software for $1-3 a disk.)

## SUGGESTED ACTIVITIES

2. Educational software (curriculum)

EBSCO Curriculum Materials Company sells a software package for creating 20 different worksheets from a database created by you with the program. The list of worksheets include word search, crossword, super cross, super search, word choice, study sheet, definition choice, etc. The software is Word Works, 1, 2, and 3. It is available in both Apple and IBM formats. Many other items are also offered. Order from:

EBSCO Curriculum Materials
Division of EBSCO Industries, Inc.
P.O. Box 262
Chelsea, AL 35043-0262
800-633-8623

(NOTE: The crossword puzzles and word search puzzles in this guide were made with this software.)

D. Posters and educational pamphlets — Available from the following:

1. Boeing Commercial Airplane Company
MS 65-47
P.O. Box 3707
Seattle, WA 98124

2. Northrop Corporation
1840 Century Park East
Los Angeles, CA 90067-2199

3. American Airlines Corporation
P.O. Box 61616
Dallas/Ft. Worth Airport, TX 75261

4. Cessna Aircraft Company
5800 East Pawnee Rd.
Wichita, KS 67201

5 National Aeronautics and Space Administration (NASA)
Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402

(NASA Regional Service Centers also offer some materials not available from the GPO.)

6. Estes Industries
1295 H Street
Penrose, CO 81240

## SUGGESTED ACTIVITIES

7. THETA Industrial Products, Inc.
P.O. Box 70
Mound, MN 55364

8. Creative Learning Systems, Inc.
9899 Hibert Suite C
San Diego, CA 92131
800-458-2880

# OVERVIEW OF TECHNOLOGY
## UNIT A-1

## TEACHER SUPPLEMENT #1—USING AIT VIDEO A-1

### Introduction and Program Summary (15:58)

This program examines what technology is, how it has evolved, and how it is used to meet human needs and solve common and uncommon problems. Opening with drummer Rick Allen of the rock band, Def Leppard, who lost his left arm in a car accident, the program shows him playing as well as ever. How does he do it? Historical footage of the building and subsequent restoration of the Statue of Liberty, work in old and new garment industry factories and developments in photography provide a backdrop to the definition of technology—"the application of knowledge and the use of resources to meet human needs and solve problems." A spin-off from the knowledge that created the moon buggy is a single joystick to control a disabled driver's van.

Resources such as materials, people, and tools have combined with knowledge to create and improve new technologies in construction; manufacturing; communication; and energy, power, and transportation. The rate of technological change is exponential; it is thought to be doubling every two to four years. The Rube Goldberg Competition carries technology to a humorous extreme—a pencil sharpener that makes use of at least 25 steps. The narrator introduces the systems model—input, process, output, and feedback—that underlies all technology. Students at an Odyssey of the Mind Competition demonstrate that problem solving can be both challenging and fun. A return to Def Leppard reveals that Rick Allen uses foot pedals linked to computers to play his drums. The program concludes by asking students how their generation will house and feed an overpopulated world.

### Video Program Objectives

The video program will illustrate that

- technology is the application of knowledge and the use of resources to meet human needs and solve problems
- there is currently an exponential increase of technology products because human knowledge is accumulating

### Before the Program

1. Tell your students that this lesson examines how technology helps solve problems. Point to a compact disc or other item seldom seen ten years ago. Ask whether these are available in the stores today. Hold up an old phonograph album or 8-track cassette; ask if they see many of these in the stores today. Explain that there were problems of sound quality, durability, and convenience with these earlier forms of audio recording devices. Technology continually produces new products to overcome problems with old ones.
2. Tell students what they will be doing in the lab, and how the content of the video program will set the stage for the laboratory activity.

## TEACHER SUPPLEMENT #1

3. Have students note the following in the video program: the definition of technology and what it does; examples of problems and how technology is solving them; the evolution and exponential growth of technology; the technology systems model; and the four technology systems.

4. Tell students to listen for the following terms. (You might write them on the chalkboard.)

technology
resources
systems model
output
Odyssey of the Mind
communication
construction
moon buggy
exponential rate
input
feedback
brainstorming
transportation
spin-offs
joystick
problem solving
process
Rube Goldberg Competition
systems of technology
manufacturing

**After the Program: Questions for Discussion and Review**

1. Ask students to define technology. (*the application of knowledge and the use of resources to meet human needs and solve problems*)

2. Ask what are some examples of problems and technological solutions shown in the video. (*the deterioration of the Statue of Liberty—the restoration of the Statue with new materials and improved structural design; long days in poor factory conditions—improved machinery and automation; sitting still for long periods of time for a photograph—instant photography and high speed film; driving a vehicle without the use of legs—joystick hand controls; Def Leppard's drummer, Rick Allen, with only one arm—now playing drums using a computer linked to foot pedals*)

3. Ask what, in addition to knowledge, are some types of resources required for technology. (*materials, people, tools*)

4. Ask students to describe how technology has grown since the beginning of mankind. What were some examples of early developments? (*Technology developed very slowly in the beginning with simple tools for hunting, making things, and growing food. Then the pace of technology became exponential, doubling every two to four years.*)

5. Ask students to name the four parts of the technology systems model. (*input, process, output, feedback*) Ask them to apply these terms to the pencil sharpener in the Rube Goldberg Competition (*input—broken pencil; process—sharpening; output—sharpened pencil; feedback—how well the pencil writes or being awarded first prize*)

6. Ask what are the four systems of technology to be explored in this videotape series. (*communication; construction; manufacturing; and energy, power, and transportation*)

7. Ask students what problems they will face in the future. How will their generation use technology to solve them? (*Students share responses and ideas.*)

## OVERVIEW OF TECHNOLOGY
## UNIT A-1

## TEACHER SUPPLEMENT #2—CROSSWORD PUZZLE

Name ______________________________ Date ________________

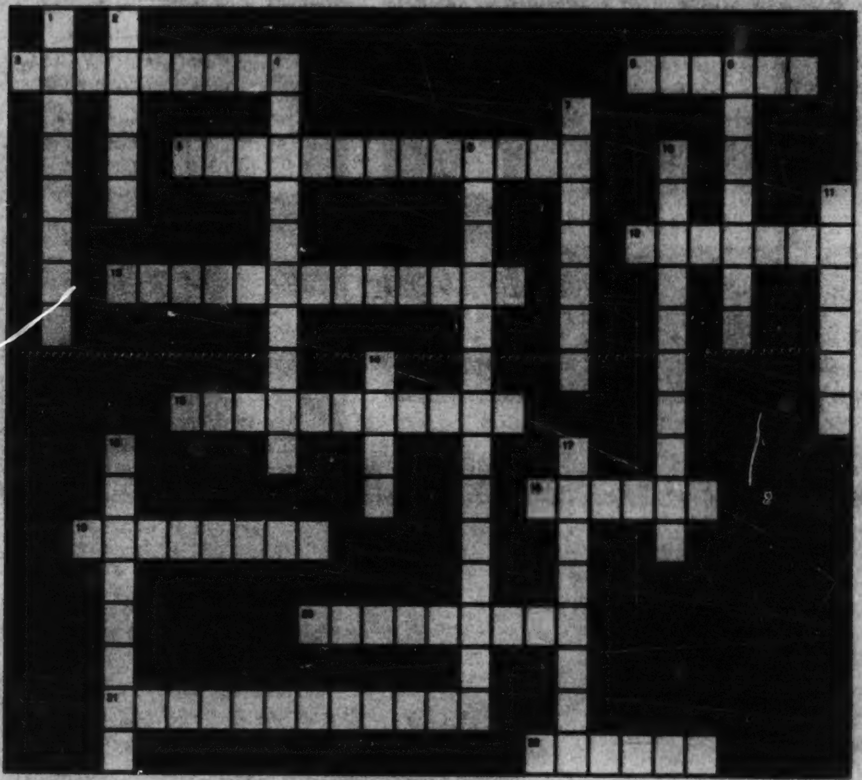
Directions: Use the clues below to solve the crossword puzzle.

### ACROSS

3. People, time, capital, tools, machines, etc.
5. The actual results of a system
8. Changing information into messages to transmit
12. Study of why natural things happen the way they do
13. Using materials and processes to produce products
15. Data that is processed
18. The capacity for doing work
19. Problem solving by making inquiries, searches, etc.
20. The physical substances that are used in a process
21. Using goods and materials to build a structure on site
22. A group of resources that produce results

### DOWN

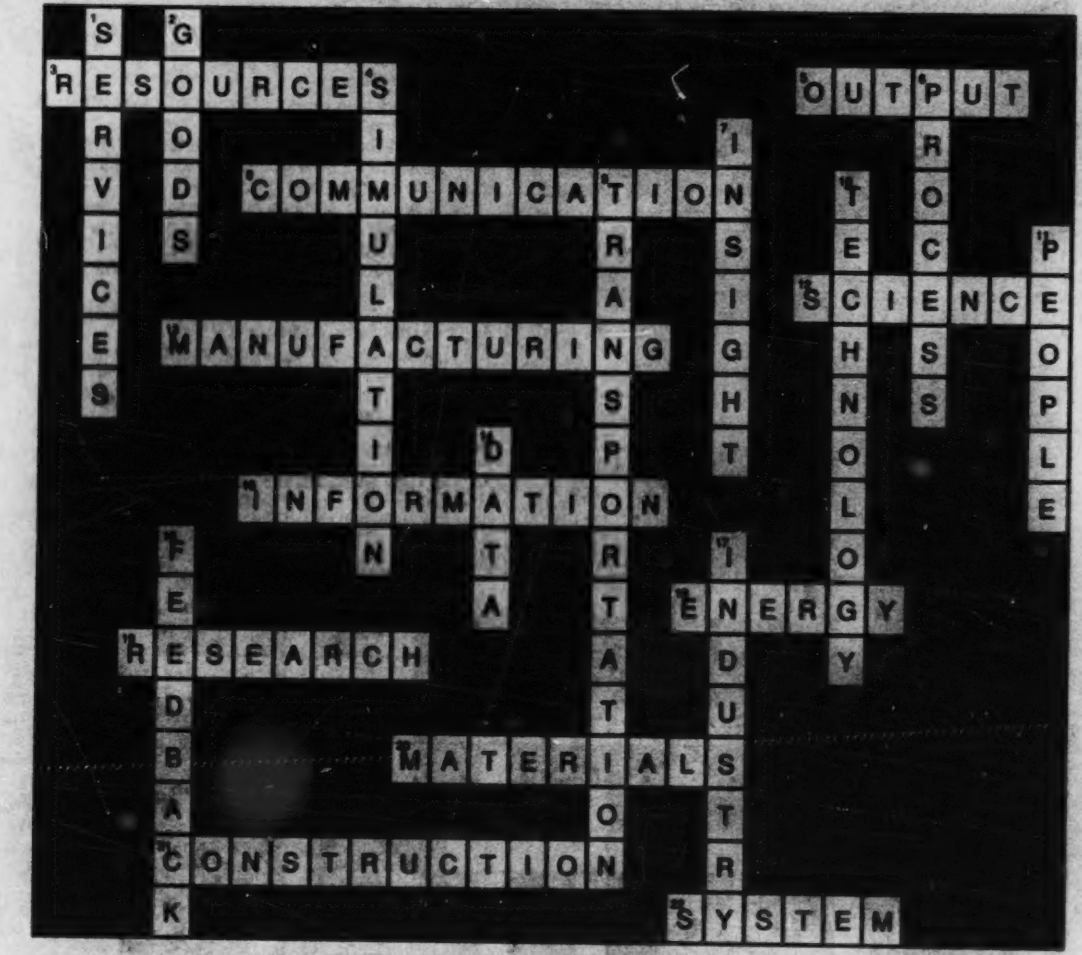
1. Work that does not produce a tangible commodity
2. Material items that are marketable commodities
4. A scale or sample model of a situation
6. The action part of a system
7. Ability to see into a situation and correct it
9. Used to move materials and products
10. The application of knowledge and the use of resources to meet human needs and solve problems
11. Design, create, and control technology
14. Raw facts and figures
16. Monitoring the system and modifying it as needed
17. An organization that produces goods or services



*Duplication Permitted*

## TEACHER SUPPLEMENT #2

## CROSSWORD PUZZLE ANSWER KEY


SERVICES
GOODS
RESOURCES
SIMULATION
OUTPUT
PROCESS
INSIGHT
COMMUNICATION
TRANSPORTATION
TECHNOLOGY
PEOPLE
SCIENCE
MANUFACTURING
DATA
INFORMATION
FEEDBACK
INDUSTRY
ENERGY
RESEARCH
MATERIALS
CONSTRUCTION
SYSTEM

# OVERVIEW OF TECHNOLOGY
# UNIT A-1

## TEACHER SUPPLEMENT #3—WORD SEARCH

Name ______________________________ Date ____________________

Directions: Find the words below hidden in the puzzle. Circle the words that you find.

TRANSPORTATION
TECHNOLOGY
SERVICES
CAPITAL
ENERGY

COMMUNICATION
SIMULATION
FEEDBACK
INSIGHT
GOODS

MANUFACTURING
RESOURCES
RESEARCH
SYSTEM
INPUT

CONSTRUCTION
MATERIALS
SCIENCE
OUTPUT
DATA

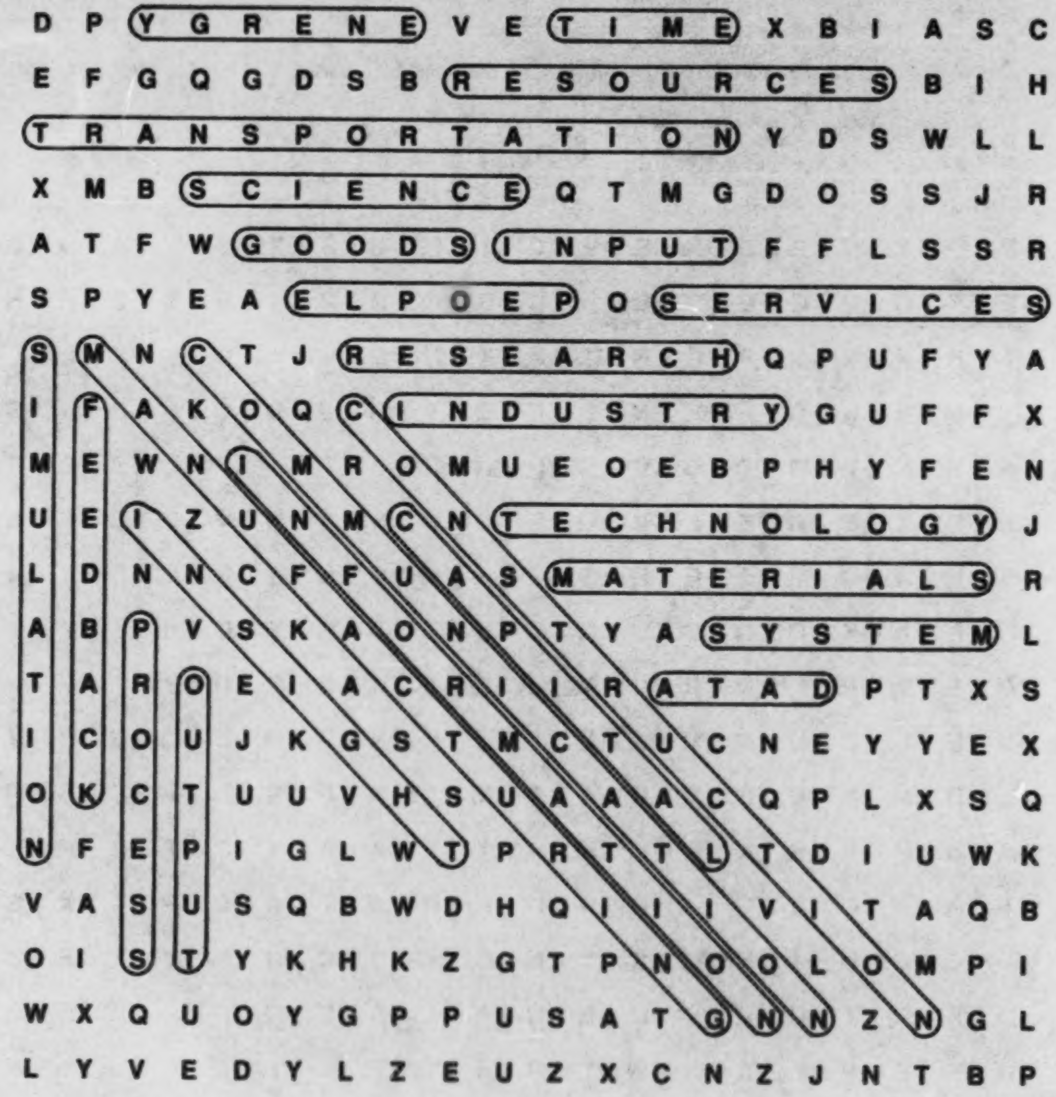
INFORMATION
INDUSTRY
PROCESS
PEOPLE
TIME

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | P | Y | G | R | E | N | E | V | E | T | I | M | E | X | B | I | A | S | C |
| E | F | G | Q | G | D | S | B | R | E | S | O | U | R | C | E | S | B | I | H |
| T | R | A | N | S | P | O | R | T | A | T | I | O | N | Y | D | S | W | L | L |
| X | M | B | S | C | I | E | N | C | E | Q | T | M | G | D | O | S | S | J | R |
| A | T | F | W | G | O | O | D | S | I | N | P | U | T | F | F | L | S | S | R |
| S | P | Y | E | A | E | L | P | O | E | P | O | S | E | R | V | I | C | E | S |
| S | M | N | C | T | J | R | E | S | E | A | R | C | H | Q | P | U | F | Y | A |
| I | F | A | K | O | Q | C | I | N | D | U | S | T | R | Y | G | U | F | F | X |
| M | E | W | N | I | M | R | O | M | U | E | O | E | B | P | H | Y | F | E | N |
| U | E | I | Z | U | N | M | C | N | T | E | C | H | N | O | L | O | G | Y | J |
| L | D | N | N | C | F | F | U | A | S | M | A | T | E | R | I | A | L | S | R |
| A | B | P | V | S | K | A | O | N | P | T | Y | A | S | Y | S | T | E | M | L |
| T | A | R | O | E | I | A | C | R | I | I | R | A | T | A | D | P | T | X | S |
| I | C | O | U | J | K | G | S | T | M | C | T | U | C | N | E | Y | Y | E | X |
| O | K | C | T | U | U | V | H | S | U | A | A | A | C | Q | P | L | X | S | Q |
| N | F | E | P | I | G | L | W | T | P | R | T | T | L | T | D | I | U | W | K |
| V | A | S | U | S | Q | B | W | D | H | Q | I | I | I | V | I | T | A | Q | B |
| O | I | S | T | Y | K | H | K | Z | G | T | P | N | O | O | L | O | M | P | I |
| W | X | Q | U | O | Y | G | P | P | U | S | A | T | G | N | N | Z | N | G | L |
| L | Y | V | E | D | Y | L | Z | E | U | Z | X | C | N | Z | J | N | T | B | P |

*Duplication Permitted*

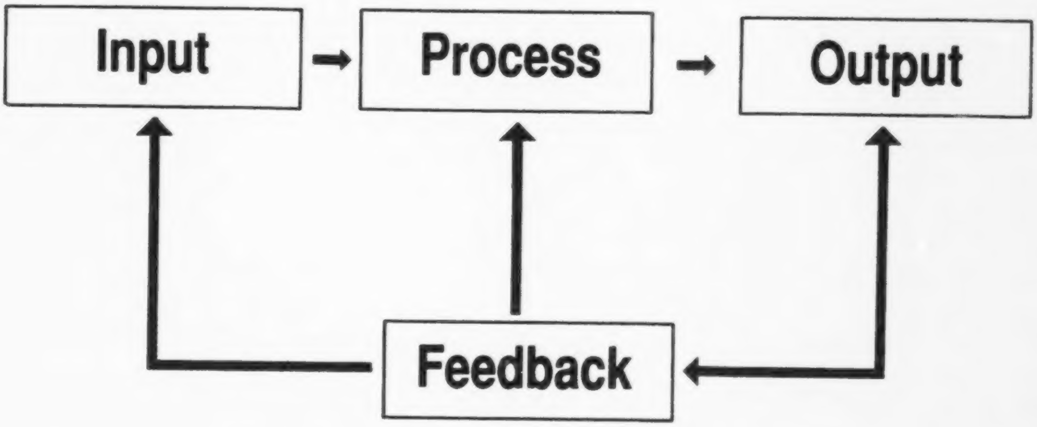
## TEACHER SUPPLEMENT #3

## WORD SEARCH ANSWER KEY



| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | P | Y | G | R | E | N | E | V | E | T | I | M | E | X | B | I | A | S | C |
| E | F | G | Q | G | D | S | B | R | E | S | O | U | R | C | E | S | B | I | H |
| T | R | A | N | S | P | O | R | T | A | T | I | O | N | Y | D | S | W | L | L |
| X | M | B | S | C | I | E | N | C | E | Q | T | M | G | D | O | S | S | J | R |
| A | T | F | W | G | O | O | D | S | I | N | P | U | T | F | F | L | S | S | R |
| S | P | Y | E | A | E | L | P | O | E | P | O | S | E | R | V | I | C | E | S |
| S | M | N | C | T | J | R | E | S | E | A | R | C | H | Q | P | U | F | Y | A |
| I | F | A | K | O | Q | C | I | N | D | U | S | T | R | Y | G | U | F | F | X |
| M | E | W | N | I | M | R | O | M | U | E | O | E | B | P | H | Y | F | E | N |
| U | E | I | Z | U | N | M | C | N | T | E | C | H | N | O | L | O | G | Y | J |
| L | D | N | N | C | F | F | U | A | S | M | A | T | E | R | I | A | L | S | R |
| A | B | P | V | S | K | A | O | N | P | T | Y | A | S | Y | S | T | E | M | L |
| T | A | R | O | E | I | A | C | R | I | I | R | A | T | A | D | P | T | X | S |
| I | C | O | U | J | K | G | S | T | M | C | T | U | C | N | E | Y | Y | E | X |
| O | K | C | T | U | U | V | H | S | U | A | A | A | C | Q | P | L | X | S | Q |
| N | F | E | P | I | G | L | W | T | P | R | T | T | L | T | D | I | U | W | K |
| V | A | S | U | S | Q | B | W | D | H | Q | I | I | I | V | I | T | A | Q | B |
| O | I | S | T | Y | K | H | K | Z | G | T | P | N | O | O | L | O | M | P | I |
| W | X | Q | U | O | Y | G | P | P | U | S | A | T | G | N | N | Z | N | G | L |
| L | Y | V | E | D | Y | L | Z | E | U | Z | X | C | N | Z | J | N | T | B | P |

# Systems Model



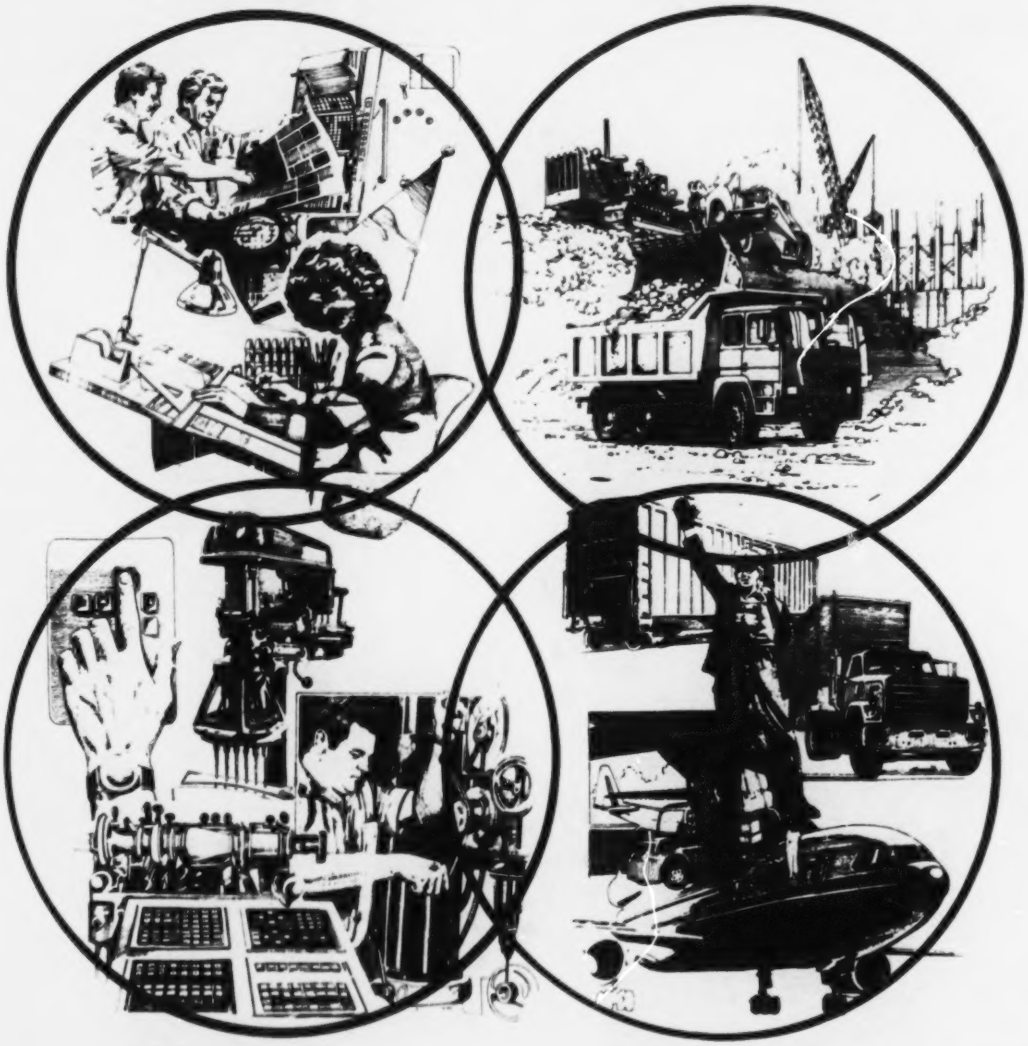
Input

Process

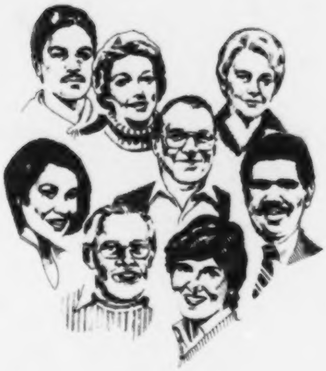
Output

Feedback

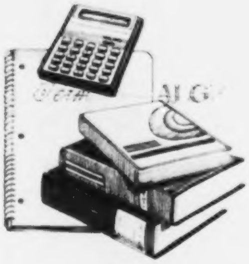
# Systems of Technology


Communication
Construction
Manufacturing
Energy, Power, and Transportation

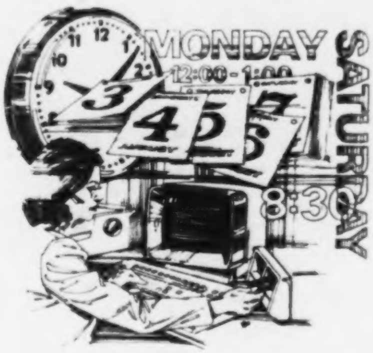
# Resources of Technology



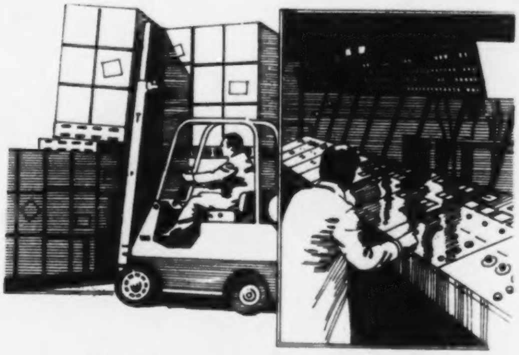
People



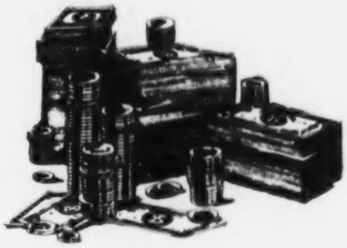
Information


MONDAY
12:00-1:00
SATURDAY
3
4
5
8:30

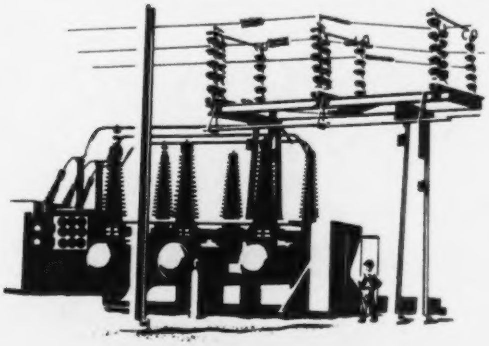
Time



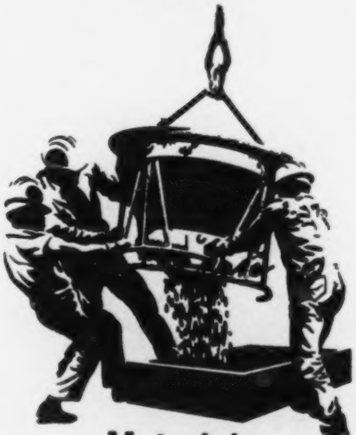
Tools and Machines



Capital

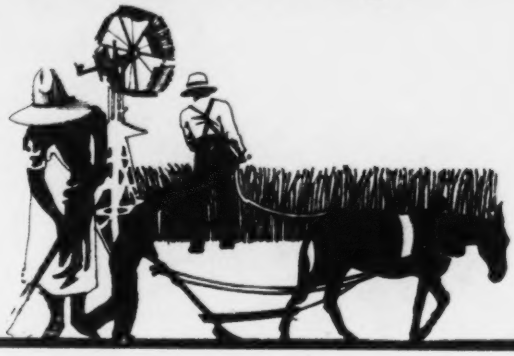


Energy



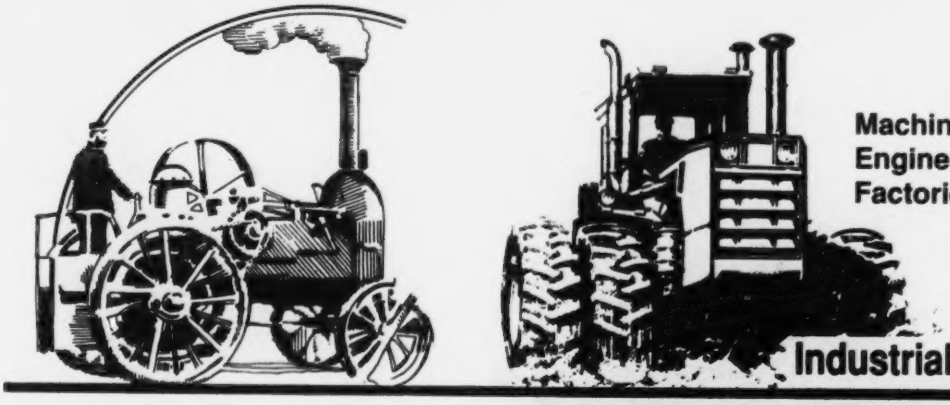
Materials

# Historical Changes in Technology



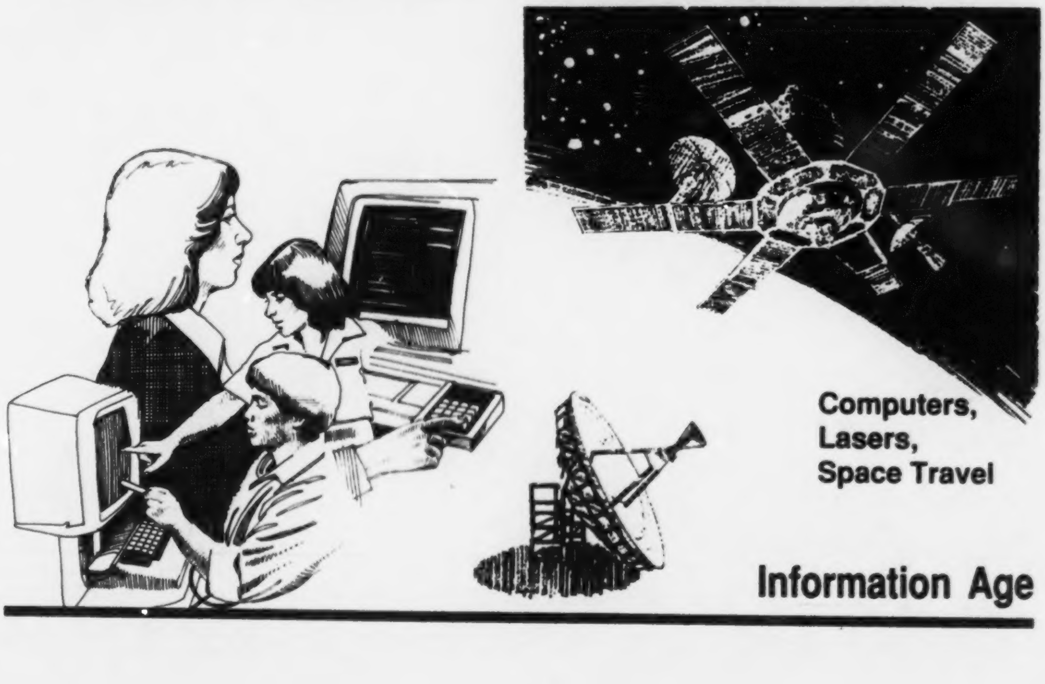
Metal Tools,
Manpower,
Horsepower

## Agricultural Age



Machines,
Engines,
Factories

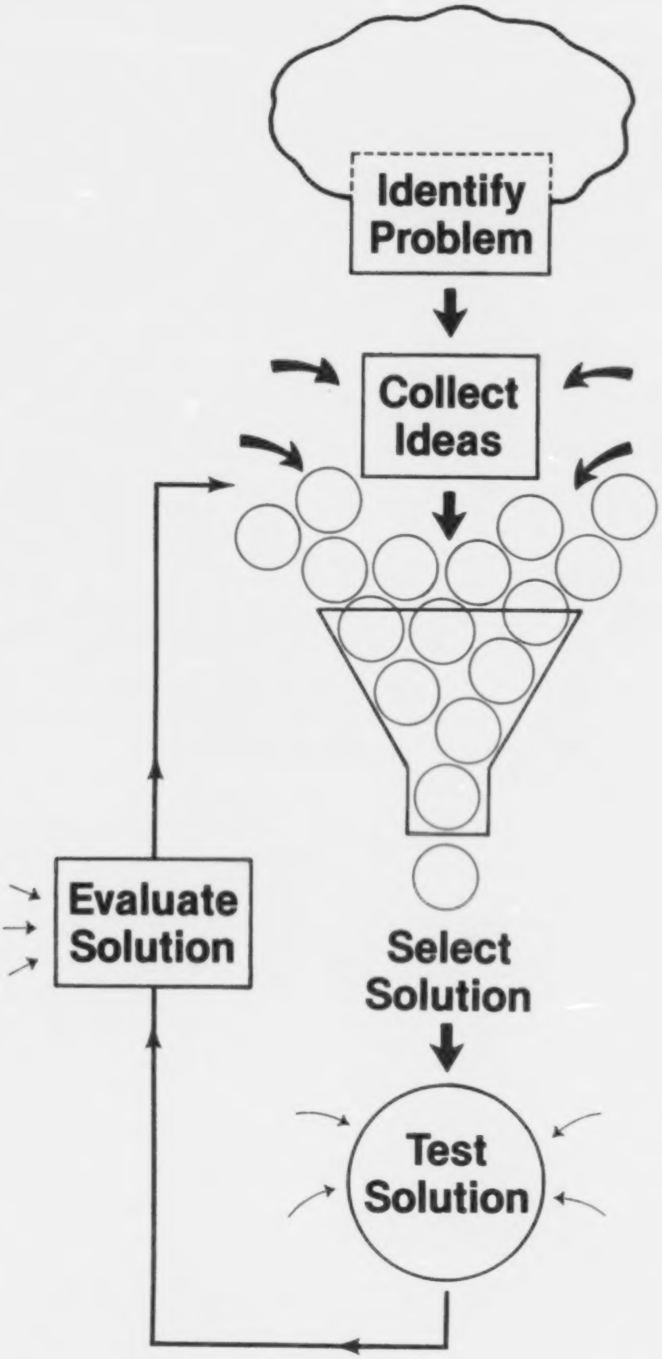
## Industrial Age



Computers,
Lasers,
Space Travel

## Information Age

# Steps in Problem Solving



Identify Problem

Collect Ideas

Select Solution

Test Solution

Evaluate Solution

# OVERVIEW OF TECHNOLOGY
## UNIT A-1

## INFORMATION SHEET

I. **Terms and definitions**

A. Data — Raw facts and figures

B. Goods — Material items that are marketable commodities or merchandise

Examples: Clothing, tools, TVs, agricultural products

C. Industry — An organization that produces goods or services

D. Resources — Those items necessary for a system to function

Examples: People, capital, tools, etc.

E. Services — Work that does not product a tangible commodity or that is for the welfare of others

Examples: Work of doctors, lawyers, teachers, military branches, entertainment industry, banks

F. System — A group of resources that function together to produce desired results

G. Systems of technology — A group of technologies used in combination to deliver products or services that meet demands

H. Systems model — Representation of a systems approach to problem solving which involves the stages of input, process, output, and feedback

I. Technology education — A program concerned with technical means, their evolution, utilization, and significance with the industrial system, products, and their social/cultural impact

II. **Definitions of science and technology**

A. Science — The study of why natural things happen the way they do

B. Technology — The application of knowledge and the use of resources to meet human needs and solve problems

## INFORMATION SHEET

### III. Parts of the systems model

A. Input — The command that one gives a system

Examples: Computer system input is information entered by keyboard.

B. Process — The action part of a system

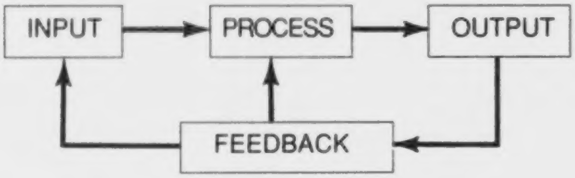
Examples: Computer system process is what the computer does with the input.

C. Output — The actual results of a system

Examples: Computer system output is what appears on monitor or printer.

D. Feedback — Monitoring the system and modifying it as needed

Example: Computer system feedback is information about the entire system. Does the computer operate properly? Is the processed data correct?



### IV. Four systems of technology (Assignment Sheet #1)

A. Communication — Changing information into messages that can be transmitted

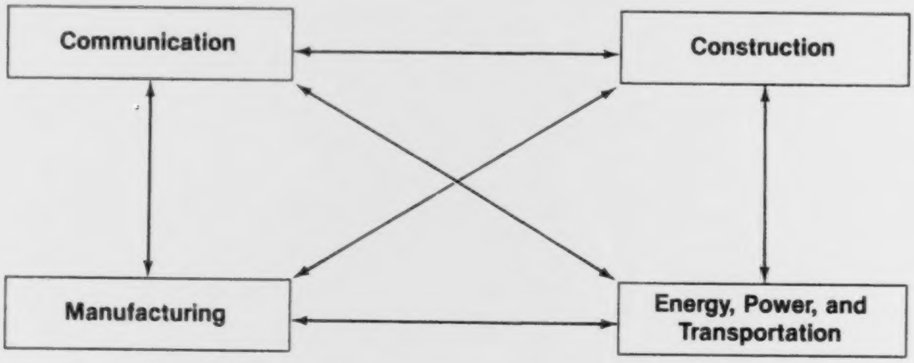
B. Construction — Using manufactured goods and materials to build structures on site

C. Manufacturing — Using materials and processes to produce usable products that are used elsewhere

D. Energy, power, and transportation — Converting energy into mechanical, fluid, and electrical power

## INFORMATION SHEET

V. **How the four systems interrelate** (Assignment Sheet #2)



A. Communication is the backbone of any organization. Information is exchanged between manufacturing plants, construction sites, and transportation industries.

B. Construction provides highways and railroads for the transportation industry as well as dams to store water for producing electrical power. The construction industry provides structures to house manufacturing and communication enterprises.

C. Manufacturing produces usable products such as construction materials and equipment, computers, machines, automobiles, trucks, and airplanes needed in the other three systems.

D. Energy, power, and transportation

  1. Energy and power — Produce, store, and transmit power for all other technology systems.

  2. Transportation — Moves materials and products for manufacturing, construction, and communication.

## INFORMATION SHEET

### VI. Resources of technology

A. People — Individuals who design, create, and control technology

B. Information — Data that can be processed

C. Materials — The physical substances that are used in a process

  1. Natural — Materials that exist in nature

  2. Synthetic — Materials that are created by humans

D. Tools and machines — Man-made devices or instruments that are used to process or maintain other resources in a system; they extend the capabilities of people

  1. Hand — Tools that require human muscle power to make them work

  2. Machine — Devices that change the amount, speed, and direction of a force

  3. Electronic — Tools that are controlled electronically

E. Energy — Resources that have the capacity for doing work

  1. Exhaustible — Those that can be used up

  2. Inexhaustible — Those that cannot be used up

F. Capital — Any form of wealth; company assets

G. Time — Measured periods during which a process can occur

## INFORMATION SHEET

### VII. Historical changes in technology

A. Early civilizations (subsistence living)

1. Food came from hunting animals and wild plants.
2. Shelter was in caves and temporary structures.
3. Most time was used to gather food to stay alive.
4. Travel was limited to areas where hunting was good.

(NOTE: The trigger that allowed society to move out of this age was the discovery and invention of the plow. For the first time, people didn't have to use all of their time to hunt for food. Now people could produce enough food for larger families and could store it for use in non-growing seasons. People could also store food for travel to more distant areas.)

B. Agrarian Age (Agricultural/handicraft-based economy)

1. Many people worked as farmers growing food.
2. Much of the work was done by hand.
3. People made most of their tools and clothing themselves.
4. Economy was based on bartering.
5. Changes took place very slowly.
6. Education was handled by master/apprentice system.

(NOTE: One trigger that brought change was the lateen sail. This sail allowed people to travel further at sea and visit new lands. This permitted trade to begin between distant countries. Another trigger was the steam engine. The development of the steam engine by Newcomen and Watt was first used to pump water out of coal mines. Its real effect was the fact that now machines could do some of the work previously done by hand.)

C. Industrial (mechanical) Age

1. Machines were invented which did work faster and easier.
2. Even fewer people were needed to grow food. People did not have to live close to the food supply. Cities grew.
3. With assembly line production, goods could be made in large quantities in factories.
4. Hand-crafted goods made locally became less important. Many things were sold in stores.

## INFORMATION SHEET

5. Faster transportation by railroads, cars, and airplanes allowed people to travel long distances.

6. Education systems trained for specific job skills.

    (NOTE: The trigger that brought change was the computer. The development of the computer increased our ability to extend our thinking and decision-making power. This came about because it allowed us to deal more easily with large amounts of information. Now fewer workers are needed to produce goods because a computer can control several machines.)

D. The Information Age (the present and future)

1. We are moving out of the Industrial Age and into the Information Age.
2. Fewer workers are needed to make and grow necessities.
3. More people are needed to process information.
4. Everything around us is changing at a very fast pace.
5. More people work in service jobs.
6. Trade markets are worldwide rather than local.
7. Communication is now instantaneous.
8. Countries can modernize faster because of all the information available.
9. Workers can expect to change jobs several times in a lifetime since technology changes their type of work.
10. Education is needed to adapt to rapid change.

**VIII. Types of American industries and examples of each**

A. Mining — Coal, metals, petroleum, nonmetallic ores

B. Construction

1. Residential — Homes
2. Commercial — Office buildings, factories, public buildings, retail business buildings
3. Civil — Railroads, airports, roads, bridges, pipelines, dams, tunnels

## INFORMATION SHEET

C. Manufacturing

1. Durable goods — Lumber and wood products, furniture, glass containers, cement, concrete, iron, steel, aluminum, electrical machinery, motor vehicles, aerospace products, appliances, instruments, electronics

2. Nondurable goods — Textile products, apparel, pulp, paper, printing, synthetic materials and plastics, tires, footwear, chemicals, drugs

D. Transportation — Railroads, automobiles, trucks, ships, airlines, aerospace

E. Power generation — Electrical plants

F. Communication — Telephone and telegraph, electrical power, radio and TV broadcasting, movies, graphic arts, drafting

G. Services — Hotels, restaurants, insurance, banking, appliance repair, vehicle repair, wholesale trade, retail trade, education, medical care

H. Agriculture — Dairy, fruit, vegetable, meat, grain, cotton, tobacco

**IX. Steps in problem solving** (Assignment Sheet #3 and Lab Activities #1 and #2)

A. Identify problem — State the problem clearly.

B. Collect ideas — Think of several possible solutions. The more ideas you have, the better chance you have of solving the problem.

C. Select best solution — Usually one idea will stand out as the best.

D. Test solution — Try out the best solution to see if it solves the problem.

E. Evaluate solution — Collect feedback and observe actual results. Modifications may be needed, or you may have to start over.

**X. Techniques used in problem solving**

A. Brainstorming — This is usually done in a group. Everyone exchanges ideas, makes suggestions, and the best solution can be chosen.

B. Role playing — A situation or problem is set up and individuals assume the identity of people involved in the situation. A dialogue is carried on to discuss the problem and its solution.

C. Trial and error — A solution is chosen that appears to be the best. That solution is tried. If it does not work, another solution is tried until the problem is solved.

D. Simulations — A scale or sample model of a situation is developed to observe the problem in a setting as near to realistic as possible in order to more clearly see the problem and possible solutions.

## INFORMATION SHEET

E. Insight — The ability to see into a situation and decide on a possible solution. Insight would be an individual's personal wisdom.

F. Research — This method of problem solving involves making inquires, searches, or investigations into the problem situation and arriving at the best possible solution.

## OVERVIEW OF TECHNOLOGY
## UNIT A-1

### ASSIGNMENT SHEET #1—IDENTIFY EXAMPLES OF THE FOUR SYSTEMS OF TECHNOLOGY IN YOUR COMMUNITY

Name ______________________________ Overall Rating __________

| EVALUATION CRITERIA | RATING |
|---|---|
| Industries are identified correctly | _____ |
| Assignment is neat and completed on time | _____ |

Introduction: Every day we come in contact with the systems of technology. In every city, town, or community there are industries (businesses or companies) that are involved in the four systems.

Directions: Listed below are the four systems of technology. Identify industries in your community that are examples of each technology system.

| Technology System | Industry Name |
|---|---|
| A. Communication | ______________________ |
| | ______________________ |
| | ______________________ |
| B. Construction | ______________________ |
| | ______________________ |
| | ______________________ |
| C. Manufacturing | ______________________ |
| | ______________________ |
| | ______________________ |
| D. Energy, power, and transportation | ______________________ |
| | ______________________ |
| | ______________________ |

ETE-37-A

## OVERVIEW OF TECHNOLOGY
## UNIT A-1

### ASSIGNMENT SHEET #2—DISCUSS THE INTERRELATIONSHIP BETWEEN THE FOUR TECHNOLOGY SYSTEMS

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Answers are appropriate | ______ |
| Assignment is neat and completed on time | ______ |

Directions: Listed are examples of items we use daily. Notice that they are from each of the technology systems. Discuss how the other systems were used to produce or sell the item.

Example: Table
(Manufacturing)

*Used to buy and sell the table*
(Communication)

*Used to manufacture the product*
(Energy, power)

*Used to move raw material and finished product*
(Transportation)

*Built the building where it was made and sold*
(Construction)

A. Television program
(Communication)

______________________________
(Manufacturing)

______________________________
(Construction)

______________________________
(Energy, power)

______________________________
(Transportation)

B. Residential home
(Construction)

______________________________
(Energy, power)

______________________________
(Transportation)

______________________________
(Manufacturing)

______________________________
(Communication)

## ASSIGNMENT SHEET #2

C. Automobile
(Manufacturing)

______________________
(Communication)

______________________
(Construction)

______________________
(Energy, power)

______________________
(Transportation)

D. Gasoline
(Energy, power, and transportation)

______________________
(Construction)

______________________
(Manufacturing)

______________________
(Communication)

## OVERVIEW OF TECHNOLOGY
## UNIT A-1

### ASSIGNMENT SHEET #3—SOLVE A PROBLEM AS AN INDIVIDUAL OR AS A GROUP

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Answers (solutions) are well thought out and appropriate | ______ |
| Answers are creative | ______ |
| Assignment is neat and completed on time | ______ |

Directions: Plan a cross-country trip to either Portland, Oregon or Boston, Massachusetts, whichever is farther away from your present location. Pretend that your trip will take place in September, 1885.

(NOTE: Your instructor may wish to change the time or destination.)

Apply the techniques used in problem solving. Use the six steps of problem solving to arrive at solutions to problems that you might experience on this trip. Answer the following questions:

1. How will you cope with the weather? ______________________________
2. How do you plan to provide for food for the trip? ______________________________
3. What clothing will you need? ______________________________
4. What other supplies will you need? ______________________________

## ASSIGNMENT SHEET #3

5. What mode(s) of transportation will you use? ______________________________

______________________________________________________________

______________________________________________________________

6. What problems do you think you might have on the trip? How could you handle these problems? ______________________________

______________________________________________________________

______________________________________________________________

## OVERVIEW OF TECHNOLOGY
## UNIT A-1

### LAB ACTIVITY SHEET #1 — CONSTRUCT A DEVICE THAT WILL SOLVE A PROBLEM ACCORDING TO STATED RULES

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Flame is extinguished on first try (penalty points will be deducted from score for each unsuccessful try) | ______ |
| Creativity/uniqueness of design | ______ |

A. Activity description:

This activity provides an opportunity for the student to demonstrate problem-solving skills. The problem will consist of designing a device utilizing a mousetrap which will put out the flame of a typical birthday candle.

B. Equipment and supplies:

Scrap materials, standard mousetrap, candle

C. Rules and regulations:

1) The only source of energy allowed is a typical mousetrap.

2) Use only the materials provided.

3) Students are to work in pairs.

4) Apply the steps for formal problem-solving.

5) The mousetrap must be at least 36" away from the candle.

6) The mousetrap may be 6" above or below the candle.

7) The operator gets one chance to put out the flame without penalty. Then each attempt is penalized.

8) The device has to put out the flame within the limit of the candle's normal life. If the flame goes out on its own accord, the operator will not have met the problem requirements.

## OVERVIEW OF TECHNOLOGY
## UNIT A-1

### LAB ACTIVITY SHEET #2—CONSTRUCT A DEVICE THAT CAN COMPETE IN A RACE ACCORDING TO STATED RULES

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Distance travelled | _____ |
| Creativity of design | _____ |

A. Activity description:

This contest provides an opportunity for the student to demonstrate problem-solving skills. The problem will consist of building a mousetrap vehicle that will travel the farthest distance. Each vehicle will compete in a distance race.

B. Equipment and supplies:

Scrap materials, standard mousetrap.

C. Rules and regulations:

1. The mousetrap vehicle may be constructed from a variety of materials such as wood, pulleys, dowel rods, levers, lubricants, etc. These materials may be provided by student or school.
2. Obtain permission before using any tools in the school's lab.
3. The only power source allowed is an ordinary mousetrap such as Victor.
4. No additional energy storing materials such as rubber bands can be used.
5. Spring on mousetrap cannot be heat-treated or altered.
6. Only one mousetrap can be attached to the vehicle at a time.
7. Apply the steps for formal problem-solving.

D. Helpful tips and suggestions:

1. Momentum and increasing mechanical advantage are important.
2. Vehicle should be designed so mousetrap can be replaced quickly.

# OVERVIEW OF TECHNOLOGY
## UNIT A-1

## TEST

Name ________________________ Score ______________

1. Match the terms on the right with the correct definitions.

______a. Representation of a systems approach to problem solving which involves the stages of input, process, output, and feedback

______b. An organization that produces goods or services

______c. Work that does not produce a tangible commodity or that is for the welfare of others

______d. Material items that are marketable commodities or merchandise

______e. Those items necessary for a system to function

______f. Raw facts and figures

1. Capital
2. Data
3. Goods
4. Industry
5. Resources
6. Services
7. System
8. Systems of technology
9. Systems model
10. Technology education

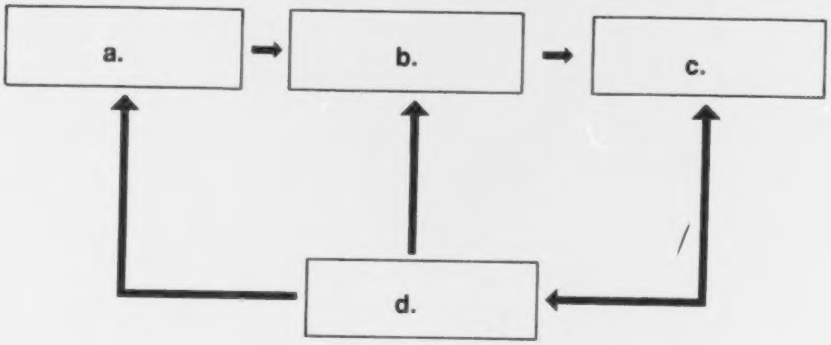
2. Distinguish between science and technology by placing an "X" next to the definition of technology.

______a. The application of knowledge and the use of resources to meet human needs and solve problems

______b. The study of why natural things happen the way they do

## TEST

3. Identify the parts of the systems model called for in the following illustration.



a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

4. Match the systems of technology listed on the right with their correct definitions.

_____a. Using materials and processes to produce usable products that are used elsewhere

_____b. Converting energy into mechanical, fluid, and electrical power

_____c. Using manufactured goods and materials to build structures on site

_____d. Changing information into messages that can be transmitted

1. Agriculture
2. Communication
3. Construction
4. Energy, power, and transportation
5. Manufacturing
6. Services

## TEST

5. Complete the following statements concerning how the four systems of technology interrelate by filling in the blanks with the following terms (not all terms must be used): *manufacturing, construction, transmit, moves, information, highways and railroads, homes, structures.*

   a. Communication is the backbone of any organization. ______________________ is exchanged between manufacturing plants and construction sites.

   b. Construction provides ______________________ for the transportation industry to travel on as well as dams to store water for producing electrical power. The construction industry provides ______________________ to house manufacturing and communication enterprises.

   c. ______________________ produces usable products such as construction materials and equipment, computers, machines, automobiles, trucks, and airplanes needed in the other systems.

   d. Energy, power, and transportation

      1) Energy and power — Produce, store, and ______________________ power for other systems.

      2) Transportation — ______________________ materials and products for other systems.

6. Match the resources of technology on the right with the correct definitions.

   _____a. Individuals who design, create, and control technology

   _____b. Data that can be processed

   _____c. Man-made devices or instruments that are used to process or maintain other resources in a system; extend the capabilities of people

   _____d. Resources that have the capacity for doing work

   _____e. Any form of wealth; company assets

   _____f. Measured periods during which a process can happen

   1. Capital
   2. Energy
   3. Information
   4. Materials
   5. People
   6. Time
   7. Tools and machines

## TEST

7. Select true statements concerning the historical changes in technology by placing an "X" next to the true statements.

_____a. Early civilizations obtained food by going to the market.

_____b. Agrarian Age people made their clothing by hand.

_____c. Goods were made in factories during the Industrial Age.

_____d. It is more difficult for countries to modernize during the Information Age.

_____e. Today education is needed to adapt to rapid change.

_____f. Early civilization people had a lot of leisure time.

_____g. Bartering was used during the Agrarian Age.

_____h. Education systems trained for specific skills during the Industrial Age.

_____i. We are presently moving into the Industrial Age.

8. List two examples for each of the following types of American industries.

a. Mining — ____________________

b. Construction — ____________________

c. Manufacturing — ____________________

d. Transportation — ____________________

e. Communication — ____________________

f. Services — ____________________

g. Agriculture — ____________________

9. Arrange in order the steps in problem solving by placing the correct sequence numbers (1-5) in the appropriate blanks.

_____a. Collect ideas

_____b. Select best solution

_____c. Identify problem

_____d. Test solution

_____e. Evaluate solution

## TEST

10. Discuss three techniques used in problem solving.

    a. ____________________________________________

    ____________________________________________

    b. ____________________________________________

    ____________________________________________

    c. ____________________________________________

    ____________________________________________

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

11. Identify examples of the four systems of technology in your community. (Assignment Sheet #1)

12. Discuss the interrelationship between the four technology systems. (Assignment Sheet #2)

13. Solve a problem as an individual or as a group. (Assignment Sheet #3)

14. Construct a device that will solve a given problem according to stated rules. (Lab Activity Sheet #1)

15. Construct a device that can compete in a race according to stated rules. (Lab Activity Sheet #2)

# OVERVIEW OF TECHNOLOGY
## UNIT A-1

## ANSWERS TO TEST

1. a. 9
   b. 4
   c. 6
   d. 3
   e. 5
   f. 2

2. a

3. a. Input
   b. Process
   c. Output
   d. Feedback

4. a. 5
   b. 4
   c. 3
   d. 2

5. a. Information
   b. Highways and railroads, structures
   c. Manufacturing
   d. 1) Transmit
      2) Moves

6. a. 5
   b. 3
   c. 7
   d. 2
   e. 1
   f. 6

7. b, c, e, g, h

## ANSWERS TO TEST

8. Any two from each of the following:

   a. Mining — Coal, metals, petroleum, nonmetallic ores
   b. Construction — Homes, office buildings, factories, public buildings, retail business buildings, railroads, airports, roads, bridges, pipelines, dams, tunnels
   c. Manufacturing
      1) Durable goods — Lumber and wood products, furniture, glass containers, cement, concrete, iron, steel, aluminum, electrical machinery, motor vehicles, aerospace products, appliances, instruments, electronics
      2) Nondurable goods — Textile products, apparel, pulp, paper, printing, synthetic materials and plastics, tires, footwear, chemicals, drugs
   d. Transportation — Railroads, automobiles, trucks, ships, airlines, aerospace
   e. Communication — Telephone and telegraph, electrical power, radio and TV broadcasting, movies, graphic arts, drafting
   f. Services — Hotels, restaurants, insurance, banking, appliance repair, vehicle repair, wholesale trade, retail trade, education, medical care
   g. Agriculture — Dairy, fruit, vegetable, meat, grain, cotton, tobacco

9. a. 2
   b. 3
   c. 1
   d. 4
   e. 5

10. Discussion should include any three of the following:

   a. Brainstorming — This is usually done in a group. Everyone exchanges ideas, makes suggestions, and the best solution can be chosen.
   b. Role playing — A situation or problem is set up and individuals assume the identity of people involved in the situation. A dialogue is carried on to discuss the problem and its solution.
   c. Trial and error — A solution is chosen that appears to be the best. That solution is tried. If it does not work, another solution is tried until the problem is solved.
   d. Simulations — A scale or sample model of a situation is developed to observe the problem in a setting as near to realistic as possible in order to more clearly see the problem and possible solutions.
   e. Insight — The ability to see into a situation and decide on a possible solution. Insight would be an individual's personal wisdom.
   f. Research — This method of problem solving involves making inquiries, searches, or investigations into the problem situation and arriving at the best possible solution.

11.-15. Evaluated to the satisfaction of the instructor

# PEOPLE, TECHNOLOGY, AND THE ENVIRONMENT
## UNIT A-2

## UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss the interrelationship between people, technology, and the environment, list environmental conservation activities, and identify correct safety practices and safety violations. Competencies will be demonstrated by completing the assignment sheets and the unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to people, technology, and the environment with the correct definitions.
2. Discuss the interrelationship between people, technology, and the environment.
3. Distinguish among the types of environmental pollution.
4. List environmental conservation activities.
5. Distinguish between recyclables and nonrecyclables.
6. Select true statements concerning general laboratory safety rules.
7. Complete statements concerning personal safety rules.
8. Match futuring techniques with the correct descriptions.
9. Complete a parent communique about safety. (Assignment Sheet #1)
10. Survey the laboratory and identify correct safety practices. (Assignment Sheet #2)
11. Identify safety violations. (Assignment Sheet #3)
12. Complete a household waste inventory sheet. (Assignment Sheet #4)

## PEOPLE, TECHNOLOGY, AND THE ENVIRONMENT
## UNIT A-2

### SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher edition only and are designed to be used with the following objectives:

TM 1 — Types of Pollution — Objective 3
TM 2 — Solid Waste — Objectives 4 and 5
TM 3 — Protective Equipment — Objective 7

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. Use Teacher Supplement #1 to present AIT video A-2. This video was developed by the Agency for Instructional Technology (AIT) and a consortium of states to accompany this publication. Contact your state supervisor of technology education for copies, or contact AIT directly for more information:

   Agency for Instructional Technology (AIT)
   Box A, Bloomington, IN 47402
   800-457-4509 or 812-339-2203

2. Use Teacher Supplements #2 and #3 to help students understand this unit's terminology. Make copies (fronts only) for your students. The answers are on the backs of the supplements.

3. Show films which discuss general and laboratory safety. Several films are listed in the Suggested Supplemental Resources. Others may be available locally.

4. Review the procedures to follow in case of fires and natural disasters.

5. Order safety posters and display them around the room. Several sources are listed in the Suggested Supplemental Resources. Others may be available locally.

## SUGGESTED ACTIVITIES

6. Have a safety poster contest where students design their own posters and a committee of students and/or teachers select the winners.

7. Use Assignment Sheet #2 to familiarize the students with the laboratory and what is expected of them.

8. Plan to teach safety of specific equipment in the area where it will be used.

   (NOTE: Many states have guides for teaching correct use of tools and equipment in technology education laboratories. Check with your state supervisor's office for the availability of a state guide.)

9. Show safety glasses that are approved for use in your state. Discuss the importance of wearing safety glasses. Discuss personal experiences where safety glasses were not worn and an eye injury resulted.

10. Show other protective devices and clothing that are required in your laboratory such as ear protection, head gear, aprons, and gloves.

11. Utilize a laboratory emergency shutdown system if possible. One system is available from:

    Paxton/Patterson
    5719 West 65th Street
    Chicago, IL 60638

12. Maintain a student record file. File parent communique about safety. (Assignment Sheet #1)

13. Have class discuss their concerns for the environment and what each of us can do to help.

14. Have students start a recycling club or use recycling as a community service project for TSA.

15. Discuss the relationship between people, technology, and the environment. Use the automobile as an example of a product of technology and discuss its impact on people and the environment.

16. Discuss the purpose in futuring technology and how it applies to the environment.

17. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Administer test.

I. Evaluate test.

J. Reteach if necessary.

## SUGGESTED ACTIVITIES

## REFERENCES USED IN DEVELOPING THIS UNIT

A. *Accident Prevention for Industrial Arts Vocational and Technical Education Programs.* Oklahoma State Board of Vocational and Technical Education.

B. "An Accident Prevention Program for School Shops and Laboratories," U.S. Department of Health, Education, and Welfare, Office of Education.

C. Badrkhan, Kamiran S., Willard R. Daggett, and Charles R. Williams. *Technology for Tomorrow.* Cincinnati, OH: South-Western Publishing Co., 1985.

D. Barden, Robert and Michael Hacker. *Living with Technology.* Albany, NY: Delmar Publishers, 1988.

E. Bohn, Ralph, et al. *Energy, Power, and Transportation Technology.* Encino, CA: Glencoe Publishing Company, 1986.

F. Goetsch, David L. and John A. Nelson. *Technology and You.* Albany, NY: Delmar Publishers, Inc., 1987.

G. McCrory, David L., Karen I. Todd, and Ronald D. Todd. *Understanding and Using Technology.* Worcester, MA: Davis Publications, Inc., 1985.

H. "Safety Practices and Procedures in School Shops," Department of Education, Division of Vocational Education, State of New Jersey.

I. *Science and Invention Encyclopedia.* "Waste Disposal," Westport, CT: H.S. Stuttman, Inc., 1987.

J. Smith, Howard Bud and R. Thomas Wright. *Understanding Technology.* South Holland, IL: The Goodheart-Willcox Company, Inc., 1989.

## SUGGESTED SUPPLEMENTAL RESOURCES

A. Safety signs, posters

1. Underwriters Laboratories, Inc.
   Public Information and Education Services
   207 East Ohio Street
   Chicago, IL 60611

2. National Safety Council
   444 North Michigan Avenue
   Chicago, IL 60611
   800-621-7619 (toll-free outside Illinois)

## SUGGESTED ACTIVITIES

B. Films and videotapes

1. *People, Technology, and the Environment.* 14 min. Color. Video. Available from:

   Agency for Instructional Technology
   Box A
   Bloomington, IN 47402
   800-457-4509

2. *Housekeeping Means Safe Keeping.* Color, 10 minutes.

3. *Stop a Fire Before It Starts.* Color, 10 minutes.

   2 and 3 are available from:

   Journal Films, Inc.
   930 Pitner Avenue
   Evanston, IL 60202

4. *Developing Shop Safety* (film) and *Color Coding* (slides). Available from:

   AAVIM
   120 Driftmier
   Athens, GA 30602

5. *The Technology Spiral.* 20 min., VHS — video about the four technology revolutions. Should be helpful for futuring technology.

   Delmar Publishers, Inc.
   2 Computer Drive, West
   Box 15015
   Albany, NY 12212

6. *Safety in the Shop Series* (16 mm or video)

   a. *Basic Practices*, 13 min.
   b. *Hand Tools*, 12 min.
   c. *Power Tools*, 13 min.

   Available from:

   Coronet/MTI Film and Video
   108 Wilmot Road
   Deerfield, IL 60015
   800-621-2131

## SUGGESTED ACTIVITIES

7. The following films are available from:

Modern Talking Picture Service
5000 Park Street North
St. Petersburg, FL 33709
813-541-5763

a. *Balancing Needs: Coal and the Environment*
b. *The Climate Factor*
c. *Global Weather Experiment*
d. *A Second Chance — Protecting Endangered Species*
e. *To Catch a Cloud: A Thoughtful Look at Acid Rain*
f. *Toxic Turmoil: The Silicon Valley Story*
g. *Trashing the Oceans*
h. *Water..It's What We Make It*
i. *Always Pure — Never Runs Dry*
j. *Upon the Waters*

8. *Acid Rain.* 17 min. Video.

9. *Recycling in Action.* 14 min. Video.

8 and 9 are available from:

Film Fair Communications
10621 Magnolia Blvd.
North Hollywood, CA 91601
818-985-0244

# PEOPLE, TECHNOLOGY, AND THE ENVIRONMENT
# UNIT A-2

## TEACHER SUPPLEMENT #1—USING AIT VIDEO A-2

### Introduction and Program Summary (13:43)

This program examines how the choices we make in using technology have both benefits and risks. Opening with footage of the first atomic bomb at Alamogordo, the program uses sequences from silent films, newsreel footage, and animation to present the car as an example of technological breakthrough of profound effects for good and ill—more jobs, transportation for all, but pollution and the "greenhouse effect." Mountain bikes and modern packaging have similarly mixed consequences. A visit to a recycling plant shows how trash can be recycled and converted to energy.

The program moves to the awarding of Nobel Prizes in Stockholm and footage of the early life of Alfred Nobel, who created dynamite to replace extremely dangerous and explosive nitroglycerin. Appalled when dynamite was put to destructive uses in war, he established the prizes, including one for peace. The program returns to Alamogordo where the bomb explodes, ending World War II but ushering in a new era. The narrator reminds us that atomic power, like all technology, is neutral. Its consequences can benefit us greatly or endanger us. We must make wise choices about the use of technologies such as pesticides, and solve the problems they create.

### Video Program Objectives

The video program will illustrate that

- technology is employed in response to problems
- technology products have consequences; some are anticipated and desired, others are not
- we must decide which technology products are appropriate in a given situation

### Before the Program

1. Explain to your students that this lesson examines desirable and undesirable consequences of technological advances. Ask them how long they watched television the previous evening. Record the results. Poll and record results, in the same manner, for conversing with family members and friends, exercising, listening to the radio, working, reading, and homework. (If students say they did homework and listened to the television in the background, divide the total amount of time between those two activities.)

   Ask your students about the consequences of watching a lot of television. List responses on the board. As a class, determine the desirable and undesirable consequences of television. Note that television is one example of a technological development that has consequences and choices (turn it on or off, how much to watch, what to watch, etc.) associated with it.

## TEACHER SUPPLEMENT #1

The video program will illustrate that when we choose to use technology to solve problems, there are consequences; some are anticipated and desired, others are not.

2. Tell students what they will be doing in the lab, and how the content of the video program will set the stage for the laboratory activity.

3. Tell students to note the following in the video program: examples of technology creating both benefits and risks or problems; the neutrality of technology; the environmental and social impacts of technology; problem solving; and decision-making choices.

4. Tell students to listen for the following terms. (You might write them on the chalkboard.)

consequences
tamper-proof
recycling
nitroglycerin
atomic power
pollution
landfills
environment
dynamite
pesticides
"greenhouse effect"
converting trash
Nobel Prize
nuclear
mountain bike

**After the Program: Questions for Discussion and Review**

1. Have students list examples of technology shown in the video program with their respective benefits and risks or problems. (*They should be ready to discuss automobiles, mountain bikes, packaging of goods, dynamite, nuclear/atomic energy, pesticides.*)

2. Have students list, describe, and discuss other examples of technologies that have consequences—good and bad. What choices do we have? (*Possible topics to stimulate ideas, discussion, and debate are use of oil, guns, large scale deforestation, newspapers, magazine articles, and television reports. Documentaries on the Discovery channel or PBS are excellent sources of information.*)

3. Ask students to suggest examples of how technology is improving life in their home or town. (*heating and air conditioning; improved insulation and construction; telephone for instant communication; skateboards and bikes that are safer, fun to ride, and provide transportation and sport; kitchen appliances that make it easier to produce meals; tools that make it easier to make or repair things [cordless electric screwdrivers]; better streets and sidewalks; traffic control; better communication with town officials; cable TV; better water and sewer systems*) Ask students to name some major differences between life today and that of 25, 50, or 100 years ago. Refrigerators? Outhouses? Calculators? Mention movies or TV shows presenting life in earlier times to help stimulate thinking about improvements.

## TEACHER SUPPLEMENT #1

4. Ask what technological problems we have in the community. What can this class or individuals in this class do to improve the situation? (*Landfills and pollution are common problems. Potential solutions are forming an ecology club and setting up a recycling program. People can recycle in their homes by separating aluminum, glass, paper products, compostable materials, and "trash".*)

5. What does the "neutrality of technology" means? (*Technology is neither good nor bad. Outcomes are determined by how we choose to use it.*)

## PEOPLE, TECHNOLOGY, AND THE ENVIRONMENT
## UNIT A-2

### TEACHER SUPPLEMENT #2—CROSSWORD PUZZLE

Name ______________________________ Date ________________

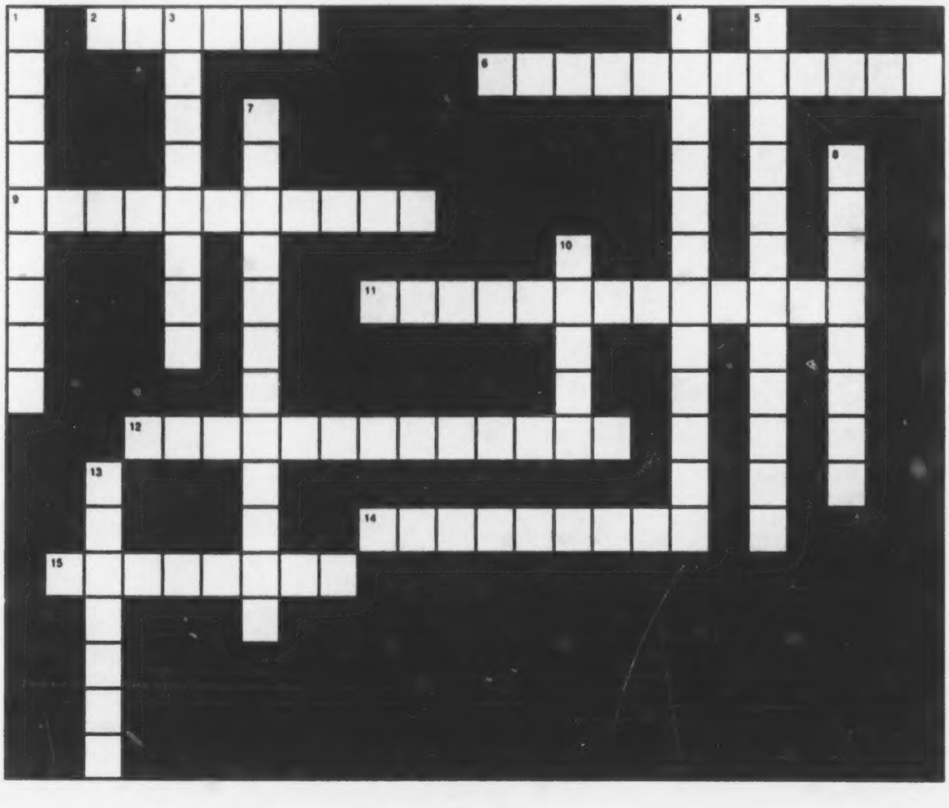
Directions: Use the clues below to solve the crossword puzzle.

ACROSS

2. Condition of being safe and free from danger
6. A survey conducted among experts
9. Natural surroundings
11. Forecasting the future based upon past actions
12. Approved _____ can save your eyesight
14. A reduction in the quality of the environment by the introduction of impurities
15. Any sudden, unintentional event causing damage

DOWN

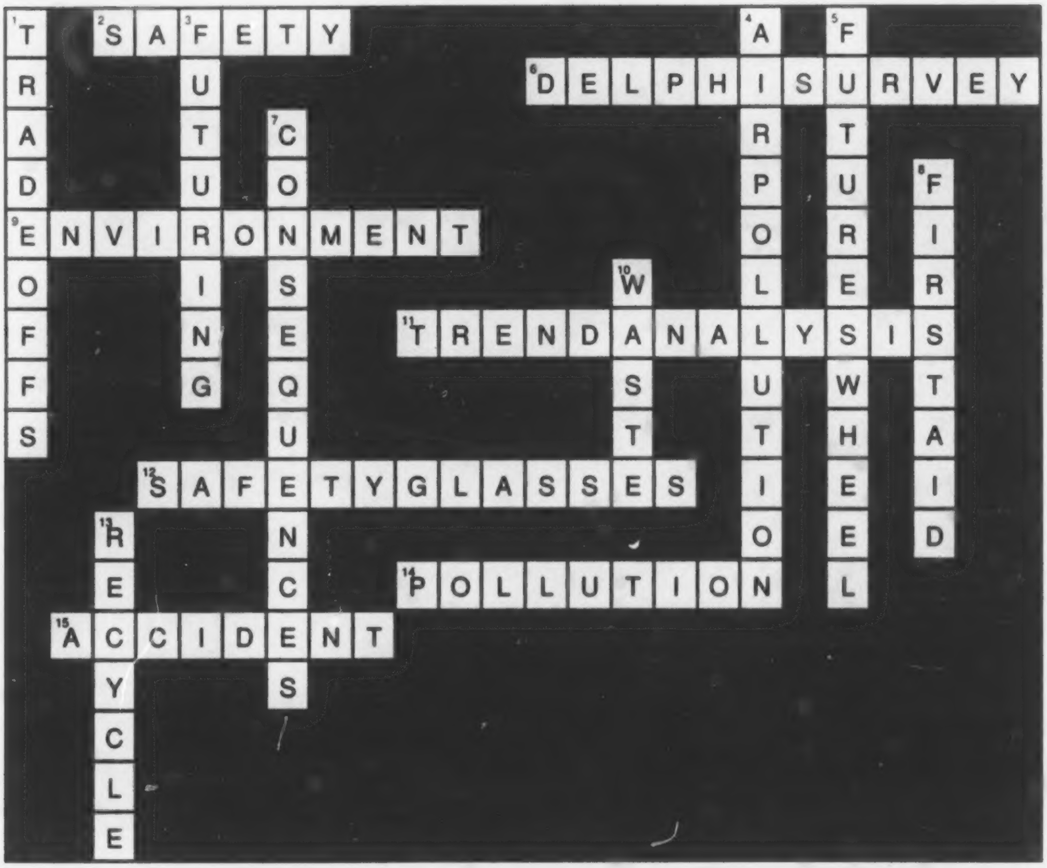
1. An exchange of benefits in one solution for the disadvantages in another solution
3. Projecting possible future outcomes
4. Caused by dust, fumes, smoke, gases, etc.
5. Start with a central idea and expand outward
7. Actions that result from other actions
8. Immediate, temporary care given to a victim
10. Useless, unwanted, or discarded material
13. To transform waste products into new products



*Duplication Permitted*

## TEACHER SUPPLEMENT #2

## CROSSWORD PUZZLE ANSWER KEY


1 TRADEOFFS
2 SAFETY
3 FUTURING
4 AIRPOLLUTION
5 FUTURESWHEEL
6 DELPHISURVEY
7 CONSEQUENCES
8 FIRSTAID
9 ENVIRONMENT
10 WASTE
11 TRENDANALYSIS
12 SAFETYGLASSES
13 RECYCLE
14 POLLUTION
15 ACCIDENT

# PEOPLE, TECHNOLOGY, AND THE ENVIRONMENT
## UNIT A-2

## TEACHER SUPPLEMENT #3—WORD SEARCH

Name ______________________________ Date ____________________

Directions: Find the words below hidden in the puzzle. Circle the words that you find.

WASTE POLLUTION
CONSERVATION
TRADEOFFS
RECYCLE
TREND ANALYSIS
AIR POLLUTION
POLLUTION
SAFETY
SOIL POLLUTION
FUTURES WHEEL
ACCIDENT
PEOPLE
SAFETY GLASSES
DELPHI SURVEY
FIRST AID
CONSEQUENCES
ENVIRONMENT
FUTURING

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | U | T | R | E | N | D | A | N | A | L | Y | S | I | S | A | Y | R | N | T |
| A | S | A | F | F | G | D | M | L | H | P | O | L | L | U | T | I | O | N | D |
| S | A | D | R | C | C | O | N | S | E | R | V | A | T | I | O | N | Q | G | J |
| T | F | I | R | D | O | W | H | T | C | H | N | W | K | O | V | N | M | P | R |
| E | E | A | C | F | E | N | F | U | T | U | R | I | N | G | P | M | D | R | H |
| P | T | T | S | L | E | L | S | T | Z | C | G | V | Z | L | T | O | J | L | E |
| O | Y | S | F | B | S | F | P | E | U | R | L | A | C | C | I | D | E | N | T |
| L | G | R | A | G | O | O | U | H | Q | P | W | Q | B | Z | M | Q | X | E | J |
| L | L | I | I | L | J | E | I | T | I | U | E | M | O | U | Q | D | O | T | K |
| U | A | F | R | T | M | R | N | L | U | S | E | O | R | W | H | T | C | H | R |
| T | S | Z | P | N | R | R | E | V | P | R | U | N | P | Y | P | H | R | U | U |
| I | S | I | O | S | I | A | G | C | I | O | E | R | C | L | A | J | A | H | G |
| O | E | T | L | Y | C | F | D | U | Y | R | L | S | V | E | E | A | N | C | Q |
| N | S | S | L | S | V | O | J | E | F | C | O | L | W | E | S | T | X | S | J |
| R | Z | T | U | A | F | X | Q | Q | O | X | L | N | U | H | Y | N | L | L | M |
| J | S | Y | T | F | N | T | N | T | J | F | F | E | M | T | E | N | S | D | W |
| Y | K | P | I | E | L | Z | J | K | C | B | F | L | G | E | I | E | X | H | R |
| H | E | S | O | T | C | U | A | A | J | V | R | S | V | K | N | O | L | X | J |
| Y | M | O | N | Y | O | H | C | R | J | O | I | Z | A | P | P | T | N | B | S |
| M | M | S | Z | U | U | V | S | B | A | W | J | D | I | Y | B | Z | E | P | I |

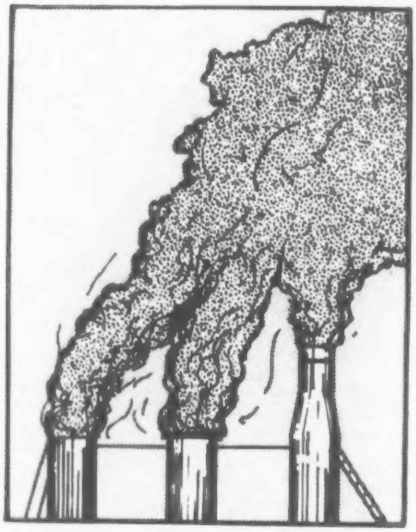
*Duplication Permitted*

## TEACHER SUPPLEMENT #3

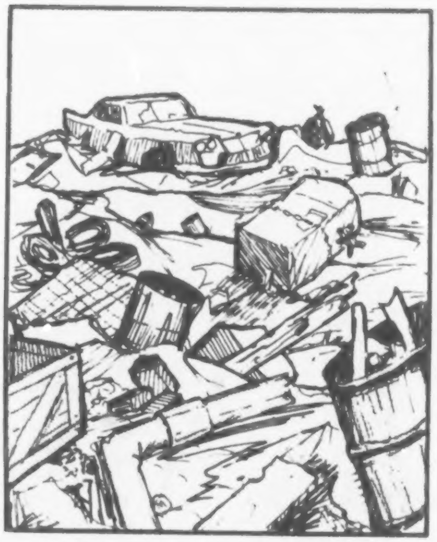
## WORD SEARCH ANSWER KEY

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | U | T | R | E | N | D | A | N | A | L | Y | S | I | S | A | Y | R | N | T |
| A | S | A | F | F | G | D | M | L | H | P | O | L | L | U | T | I | O | N | D |
| S | A | D | R | C | C | O | N | S | E | R | V | A | T | I | O | N | Q | G | J |
| T | F | I | R | D | O | W | H | T | C | H | N | W | K | O | V | N | M | P | R |
| E | E | A | C | F | E | N | F | U | T | U | R | I | N | G | P | M | D | R | H |
| P | T | T | S | L | E | L | S | T | Z | C | G | V | Z | L | T | O | J | L | E |
| O | Y | S | F | B | S | F | P | E | U | R | L | A | C | C | I | D | E | N | T |
| L | G | R | A | G | O | O | U | H | Q | P | W | Q | B | Z | M | Q | X | E | J |
| L | L | I | I | I | J | E | I | T | I | U | E | M | O | U | Q | D | O | T | K |
| U | A | F | R | T | M | R | N | L | U | S | E | O | R | W | H | T | C | H | R |
| T | S | Z | P | N | R | R | E | V | P | R | U | N | P | Y | P | H | R | U | U |
| I | S | I | O | S | I | A | G | C | I | O | E | R | C | L | A | J | A | H | G |
| O | E | T | L | Y | C | F | D | U | Y | R | L | S | V | E | E | A | N | C | Q |
| N | S | S | L | S | V | O | J | E | F | C | O | L | W | E | S | T | X | S | J |
| R | Z | T | U | A | F | X | Q | Q | O | X | L | N | U | H | Y | N | L | L | M |
| J | S | Y | T | F | N | T | N | T | J | F | F | E | M | T | E | N | S | D | W |
| Y | K | P | I | E | L | Z | J | K | C | B | F | L | G | E | I | E | X | H | R |
| H | E | S | O | T | C | U | A | A | J | V | R | S | V | K | N | O | L | X | J |
| Y | M | O | N | Y | O | H | C | R | J | O | I | Z | A | P | P | T | N | B | S |
| M | M | S | Z | U | U | V | S | B | A | W | J | D | I | Y | B | Z | E | P | I |

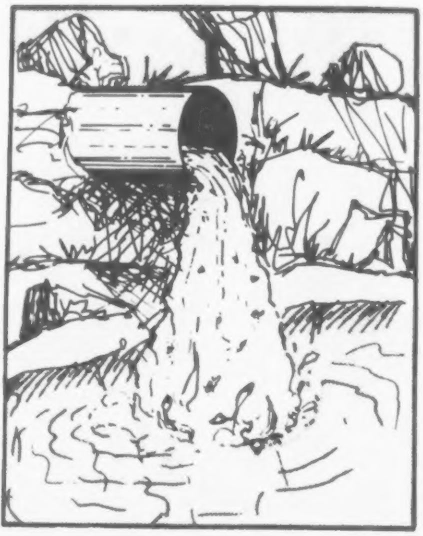
# Types of Pollution



Air Pollution

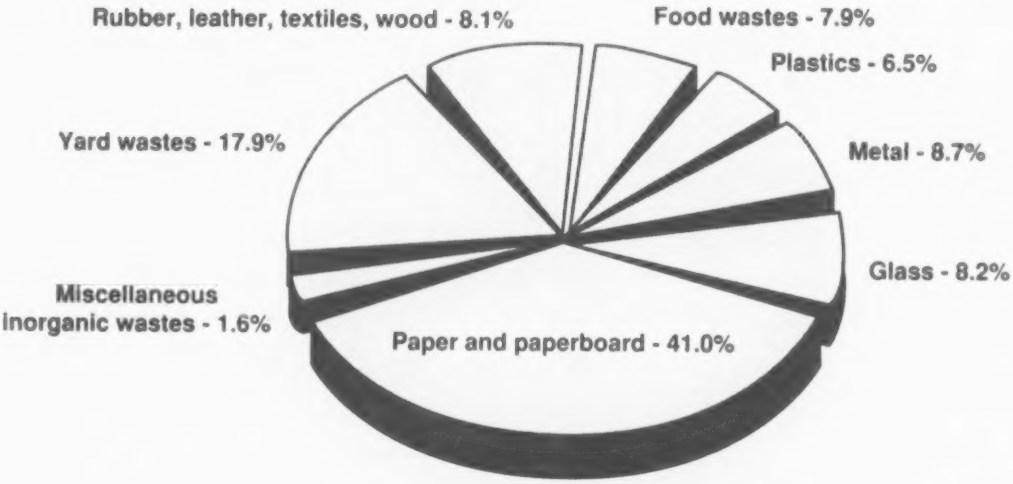


Land Pollution

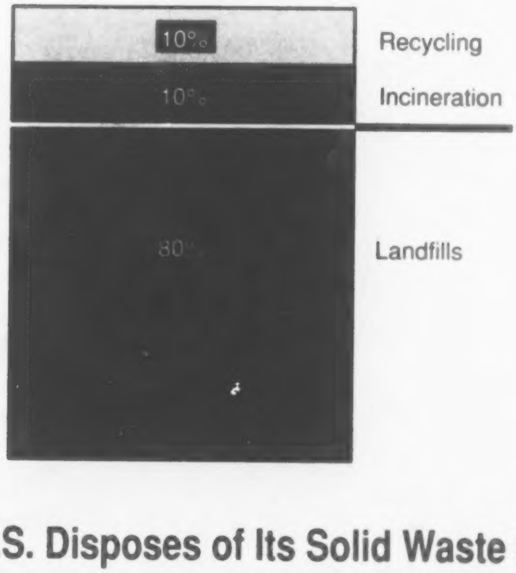


Water Pollution

# Solid Waste

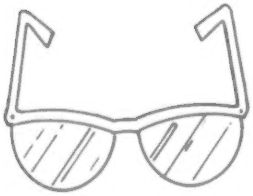


Composition of Municipal Waste

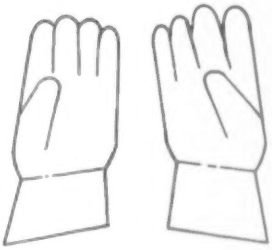


How U.S. Disposes of Its Solid Waste (1989)

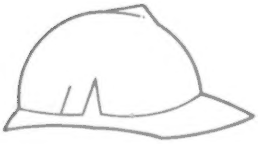
# Protective Equipment



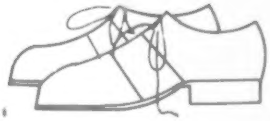
Eye Protection



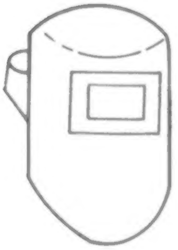
Gloves



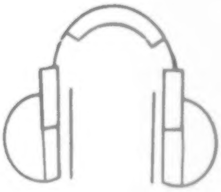
Protective Head Gear



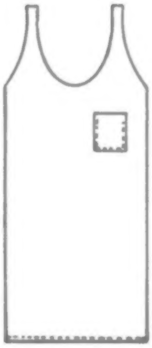
Steel-Toed Shoes



Face Shield



Ear Protection



Apron

# PEOPLE, TECHNOLOGY, AND THE ENVIRONMENT
## UNIT A-2

## INFORMATION SHEET

I. **Terms and definitions**

A. Accident — Any sudden, unintentional event which causes personal injury or damage

B. Biodegradable — A material that decomposes in the environment as a result of biological action (microorganisms)

(NOTE: Products vary in the amount of time they require to degrade, from a few weeks to thousands of years. However, many biodegradable products will never degrade without sunlight or oxygen which may be lacking in a landfill.)

C. Consequences — Actions that result from other actions

D. Conservation — Planned management of a natural resource which minimizes waste and maintains that resource for future use

E. Ecosystem — A unit of the environment comprising the interactions of all organisms and the physical components within a given area

F. Environment — Natural surroundings including physical, chemical, and living factors such as soil, climate, plants, and animals

G. First aid — Immediate, temporary care given an accident victim until services of a physician can be obtained

H. Futuring — Projecting possible future outcomes of a given system or situation and analyzing the effects of each

I. Natural resource — A source of wealth or revenue supplied by nature and used by humans

J. Pollution — A reduction in the quality of the environment by the introduction of impurities

K. Recycle — To transform waste products into new products

L. Safety — State or condition of being safe and free from danger, risk, or injury

M. Toxic — Poisonous; hazardous to plant and animal life even at very low concentrations

N. Tradeoffs — An exchange of the benefits in one solution for the disadvantages in another solution

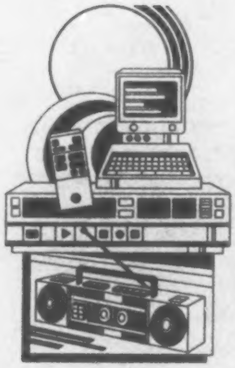
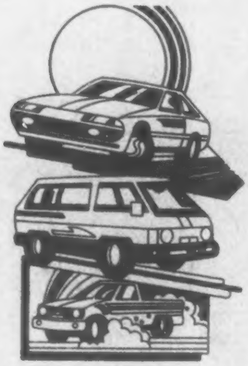
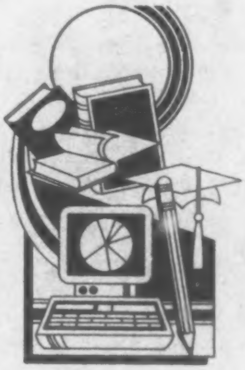
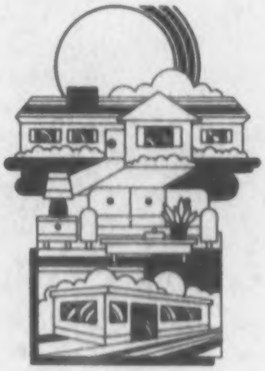
O. Waste — Useless, unwanted, or discarded material

# INFORMATION SHEET

## II. Interrelationship between technology, people, and the environment

A. Technology satisfies the needs and wants of people.

Examples: Manufactured goods, food, health care, transportation, education, housing

B. People use technology to control their environment.

Examples: Building bridges to cross rivers, building homes to protect us from adverse climate conditions, using heaters and air-conditioners for comfort, building solar cells to capture the sun's energy so it can be used in various ways, inventing devices so we can communicate over longer distances

C. The environment can be damaged by people and their use of technology.

Examples: Pollution, loss of wildlife species, destroying natural resources

## III. Types of environmental pollution

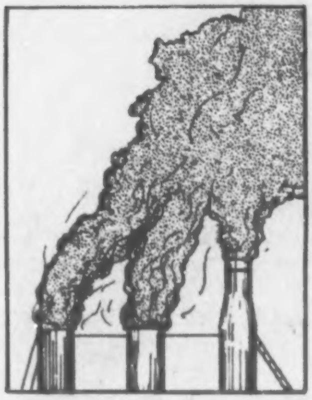
A. **Air pollution** from automobile exhaust, industrial emissions, dust, and smoke

B. **Water pollution** from domestic sewage entering waterways before proper treatment, and industrial waste improperly disposed of in landfills that moves down into the groundwater

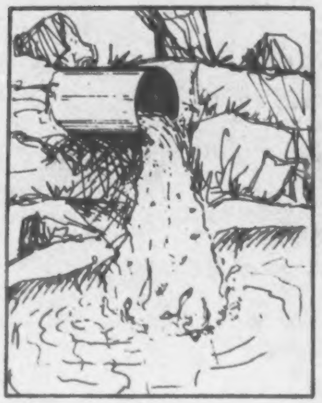
C. **Land (soil) pollution** from pesticides, toxic waste, acid rain, and disposal of solid waste on the land

## INFORMATION SHEET

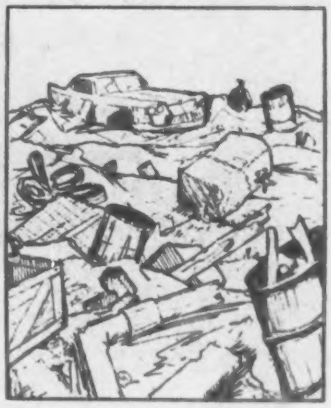
Air Pollution



Water Pollution



Land Pollution



### IV. Environmental conservation activities

A. Air conservation activities

1. Since cars are major air polluters, keep cars tuned up, change fuel filters often, maintain emission control devices, and use unleaded gasoline.

2. Drive less, ride more. Use mass-transit, car pools, bicycles, or walk to work or school.

   (NOTE: The less you use your car, the less pollutants you put into the environment.)

3. Avoid using toxic chemicals released into the air such as oven cleaners and window cleaners. Instead use water and soap, baking soda, or vinegar.

4. Plant trees. These use carbon dioxide and produce oxygen. Trees also help to purify the air.

B. Water conservation activities

1. Use low-flow shower heads. Short showers also use less water than baths.

2. Use faucet aerators for each sink.

3. Run washing machines and dishwashers only when they are full.

## INFORMATION SHEET

4. Do not let faucets run while hand-washing dishes or brushing teeth.

   (NOTE: The average home faucet uses 5 gallons of water per minute!)

5. Water plants and lawns only as needed, and only in the morning to reduce evaporation.

6. Fix leaky faucets or toilets.

C. Soil (land) conservation activities

1. Keep soil covered with grass, ground covers, trees, and plants to prevent erosion.

2. Reduce waste that would normally go to the landfill by recycling as much as possible and by buying products made from recycled materials.

3. Do not send toxic substances such as oils, pesticides, or batteries to the municipal landfill.

   (NOTE: Call your fire department about disposing of toxic waste.)

D. Energy conservation activities

1. Seal leaks and cracks around doors and windows with caulking and weather stripping.

2. Increase the insulation in your home to the maximum recommendation.

3. Drive fuel-efficient vehicles.

4. Use mass-transit, carpools, bicycles, or walk.

   (NOTE: This cuts down on the fuel used as well as decreases air pollutants.)

5. Set hot water heater at 120°F.

6. Use a cooler wash and cooler rinse in washing machines.

7. Turn down the heater at night.

8. Use fluorescent lights instead of incandescent.

   (NOTE: Fluorescents use only one-fourth of the energy.)

9. Turn lights and TV off when not using them.

10. Check for leaks around the refrigerator door. Also check the temperature. Set at 38°-42°.

11. Use high-efficiency appliances and those with energy-saving features.

## INFORMATION SHEET

12. Use microwave ovens and pressure cookers. They use less energy, as well as save time.

13. Use alternative energies (solar, wind) where possible to lessen demand on nonrenewable energies (fossil fuels).

14. Use products that are recycled, recyclable, repairable, refillable, reusable, and long-lasting.

    (NOTE: It uses less energy to recycle or reuse a product than to manufacture a new one from raw material.)

**V. Recyclables and nonrecyclables**

A. Recyclables

1. Materials

   - Paper — Newspapers, corrugated boxes, office papers, mixed papers
   - Plastic — Milk, soft drink, and other containers
   - Glass — Bottles and jars
   - Aluminum — Cans and other aluminum products
   - Steel — Appliances and other steel products
   - Scrap metal — Food cans, etc.
   - Wood — Pallets, lumber, etc.
   - Motor oils

2. Compost

   - Leaves, grass, and brush
   - Food wastes (vegetables - not meat)
   - Some other organic materials, such as paper contaminated with food

B. Nonrecyclables

- Wastes heavily contaminated by food residues, household chemicals, or dirt
- Composite materials — Materials that cannot be separated

  Examples: Aseptic boxes made of paper, foil, and adhesives, plastic-coated paper, furniture and appliances (other than their metal content), paper with a glossy varnish finish such as magazines

## INFORMATION SHEET

- Miscellaneous inorganics, such as street sweepings

  (NOTE: At present, approximately 10 percent of all U.S. solid waste is recycled, but experts estimate that its full potential may be as high as 50 percent.)

### VI. Laboratory rules to promote a safer environment

A. Use tools and equipment only for their intended purposes.

B. Return all tools to their proper places after use.

C. Keep all hand tools sharp, clean, and in safe working order.

D. Report any defective tools, machines, or other equipment to the instructor.

E. Retain all guards and safety devices except with the specific authorization of the instructor.

F. Make sure all guards and barriers are in place and adjusted properly before starting a machine tool.

G. Operate machines and tools only after receiving instruction on how to use them safely.

H. Use machinery only under supervision.

I. Follow the specific safety rules for specific machines.

J. Turn off the power and remain at the machine until all moving parts have come to a stop.

K. Disconnect the power from machines before performing the maintenance task of oiling or cleaning.

L. Use correct, properly fitting wrenches for nuts, bolts, and objects to be turned or held.

M. Clean the chips from a machine with a brush—not with a rag or bare hands.

N. Report any unsafe condition or practice in the laboratory immediately.

O. Do not get involved in any horseplay in laboratory or classroom area.

P. Use a solvent only after determining its properties, what it is used for, and how to use it.

   (NOTE: Always read labels before using a product.)

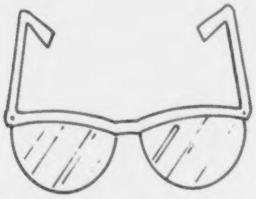
Q. Report all accidents to the instructor regardless of nature or severity.

## INFORMATION SHEET

### VII. Personal safety rules to improve your immediate surrounding environment

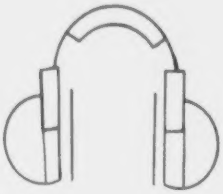
A. Wear protective equipment as required.

1. Approved safety glasses can save your eyesight! There are many hazards that your eyes might come in contact with, so be prepared.



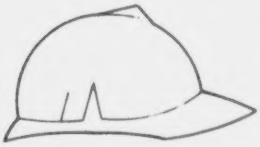
**Eye Protection**

2. Ear protection can prevent damage to your hearing.

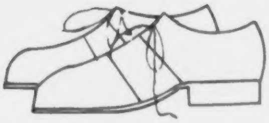


**Ear Protection**

3. Approved head gear (hard hats) and steel-toed shoes are especially valuable on construction sites.

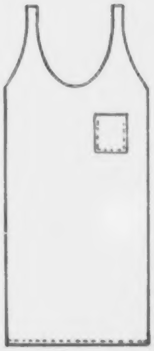


**Protective Head Gear**



**Steel-Toed Shoes**

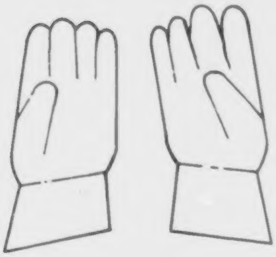
4. Aprons are required when mixing strong chemicals.



**Apron**

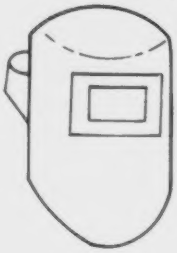
## INFORMATION SHEET

5. Different kinds of gloves are used to protect your hands from rough surfaces or chemicals.



**Gloves**

6. Face shields are required when welding. (NOTE: Contact lens wearers must use extra caution around heat such as welders.)



**Face Shield**

B. Secure long hair and loose clothing such as ties, scarves, or wide sleeves when working around machines or rotating equipment.

C. Remove rings and other jewelry when working in the laboratory.

D. Conduct yourself in a manner conducive to safe laboratory practices.

E. Use soap and water frequently as a method of preventing skin irritations.

F. Work only in well-ventilated areas.

### VIII. Futuring techniques for people, technology, and the environment

A. Cross-impact analysis — Identify several possible futures and what the combined results may be

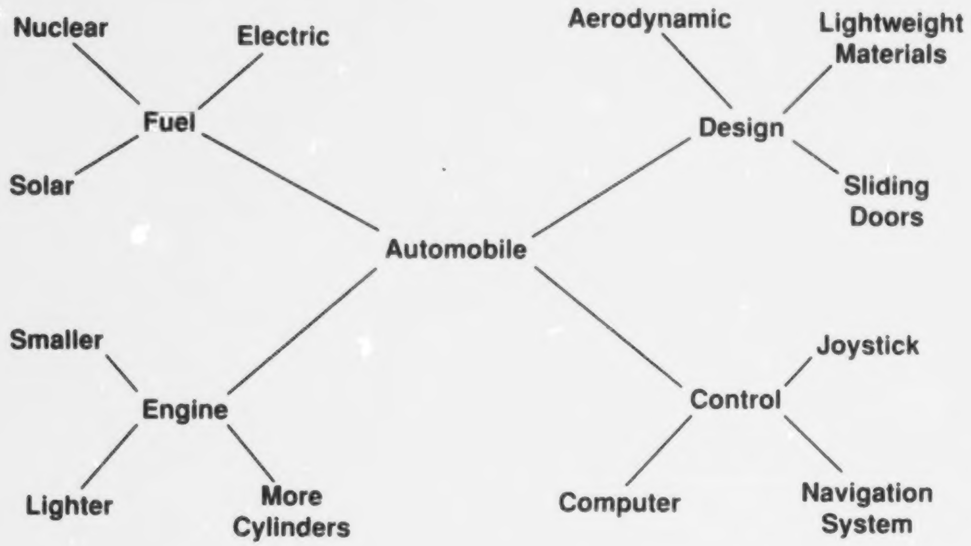
B. Delphi survey — A survey conducted among experts to identify the most likely futures. The survey consists of listing and ranking possible futures.

C. Trend analysis — Forecasting the future based upon past actions

D. Future histories — Requires you to image yourself in the far future

## INFORMATION SHEET

E. Futures wheel — Start with a central idea and expand the idea outward forming a wheel


Nuclear
Electric
Aerodynamic
Lightweight Materials
Fuel
Design
Solar
Sliding Doors
Automobile
Smaller
Joystick
Engine
Control
Lighter
More Cylinders
Computer
Navigation System

# PEOPLE, TECHNOLOGY, AND THE ENVIRONMENT
## UNIT A-2

## ASSIGNMENT SHEET #1 — COMPLETE A PARENT COMMUNIQUE ABOUT SAFETY

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Properly signed | ______ |
| Completed on time | ______ |

### SAFETY IN THE TECHNOLOGY EDUCATION PROGRAM

____________________ is enrolled in our Technology Education program and will have the opportunity to use various tools and equipment. Appropriate instruction in the safe operation of these tools and equipment is given and close supervision is maintained at all times. Although every precaution is taken to prevent accidents, a certain risk is involved due to the nature of the experience, the age of the student, and the learning environment.

We are asking cooperation in impressing upon your child the importance of being careful. This we believe will back up the instruction that is given in school.

We welcome and encourage your visit to our school and the technology education department to see our program. These visits can be arranged by calling the school or by your son or daughter.

"I have read the above communication and I understand the type of program that ____________________ is enrolled in. I will stress the safety aspects of this program to my child. I encourage my child to participate fully in this technology education program."

______________________________ ____________________
*(signature of parent)* *(date)*

Phone ____________________ (Home) ____________________ (Work)

Please identify any health problems which may have a bearing on your child's participation in this class.

____________________________________________________________

____________________________________________________________

"I agree to observe all safety rules and procedures for safe operation and conduct in the school technology lab, and I will wear approved eye protection at all times while in the laboratory in accordance with the state law."

______________________________ ____________________
*(signature of student)* *(date)*

## PEOPLE, TECHNOLOGY, AND THE ENVIRONMENT
## UNIT A-2

## ASSIGNMENT SHEET #2 — SURVEY THE LABORATORY AND IDENTIFY CORRECT SAFETY PRACTICES

Name ______________________ Overall Rating __________

| EVALUATION CRITERIA | RATING |
|---|---|
| Answers are appropriate | ______ |
| Completed on time | ______ |

A. What safety practices are being used in your laboratory to promote general safety?

B. What practices are used to maintain an orderly laboratory?

C. Where is your laboratory fire extinguisher located? What type is it? On what kinds of fires may it be used?

D. Where is your laboratory first aid kit located? Who is permitted to use it?

E. What equipment and machines in your lab must you have separate safety tests on before you are allowed to operate them? ______________________

F. What personal safety protection devices or clothing must you wear while working in the laboratory? ______________________

## ASSIGNMENT SHEET #2

G. What procedure should you follow if you see an accident happen? ____________

________________________________________________________________

________________________________________________________________

# PEOPLE, TECHNOLOGY, AND THE ENVIRONMENT
## UNIT A-2

## ASSIGNMENT SHEET #3 — IDENTIFY SAFETY VIOLATIONS

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Violations are identified | ______ |
| Assignment is completed on time | ______ |

Directions: The following paragraphs describe unsafe acts performed by a careless student. List the violations on the next page.

While the instructor was out of the laboratory, a student had to make up work he had missed in school. He had passed all the safety tests on all the machines in the laboratory so there was no reason why he couldn't catch up. The student was wearing a long-sleeve shirt, so he rolled up his sleeves and put his watch in his pocket.

The only drill that was available had a frayed cord, but was all right to use because there was only a little bare wire exposed. Before plugging it in, he made sure the locking switch was locked on and that the tool was properly grounded. When he started drilling, he made sure that the cord was looped over his wrist to prevent it from getting in the way of the operations. He did notice that there was a puddle under his feet, but he was able to keep the cord from getting wet.

After drilling the first hole, he made sure that the locking switch was off but did not unplug it because he didn't want to further damage the frayed cord. He then changed the drill bit for a larger hole. His safety glasses kept sliding down his nose, so he took them off because there was no real danger when he was just drilling. When he was finished with the drill, he put it on the floor to keep the bench area from getting cluttered.

He then got out the circular saw to make a few crosscuts. Seeing the possible dangers with the saw compared to the drill, he put his safety glasses back on. He made sure the locking switch was off and then plugged it in. He placed the cord over his shoulder to keep it out of the path of the saw and proceeded to make the cut. The board seemed a little difficult to cut, but he was puzzled because the blade was out as far as it could go and he was only cutting one-inch stock. He then started smelling a strange burning odor, so he immediately turned off the machine and jammed the saw into the wood to stop it as quickly as possible.

He put away the bad saw and then got out another saw to finish the cut. After he finished the cut and released the locking switch, he noticed that the guard had retracted properly so there was no need to wait until the blade had stopped rotating. He then put away the tools and cleaned up his mess like a good student should do.

## ASSIGNMENT SHEET #3

List all the safety violations.

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________
7. ______________________________
8. ______________________________
9. ______________________________
10. ______________________________

# PEOPLE, TECHNOLOGY, AND THE ENVIRONMENT
UNIT A-2

## ASSIGNMENT SHEET #4 — COMPLETE A HOUSEHOLD WASTE INVENTORY SHEET

Name ______________________ Overall Rating __________

| EVALUATION CRITERIA | RATING |
|---|---|
| List is complete | ______ |
| Items are classified correctly | ______ |
| Assignment is neat and completed on time | ______ |

Directions: List all items thrown away by your household for five days. Classify all items as recyclable or nonrecyclable. Then answer the questions that follow.

| DAY | WASTE ITEMS | RECYCLABLE? (Yes or no) |
|---|---|---|
| #1 | | |
| #2 | | |

## ASSIGNMENT SHEET #4

| DAY | WASTE ITEMS | RECYCLABLE? (Yes or no) |
|---|---|---|
| #3 | | |
| #4 | | |
| #5 | | |

## ASSIGNMENT SHEET #4

1. What items composed the largest percentage (by volume) of your waste? ______

______

2. Where does your trash eventually end up in your town or city? ______

______

3. How could you reduce the volume of your waste? ______

______

4. Are there recycling centers in your hometown? ______

   List them below. ______

   ______

   ______

## PEOPLE, TECHNOLOGY, AND THE ENVIRONMENT
## UNIT A-2

### ANSWERS TO ASSIGNMENT SHEETS

**Assignment Sheet #1**

Evaluated according to the stated criteria. File in student's folder.

**Assignment Sheet #2**

Evaluated according to the stated criteria. Use this assignment to stress how each student can assist in maintaining a safe and orderly laboratory.

**Assignment Sheet #3**

Evaluated according to the stated criteria. Students should have listed ten of the following violations.

1. Do not work in a laboratory without supervision or special permission.
2. Never use a power tool with a frayed or damaged cord, and report it to the instructor.
3. Before plugging in a power tool, make sure the switch is off.
4. Never operate an electrical power tool in or around water.
5. When changing drill bits, always unplug the power tool.
6. Always wear approved eye protection in a laboratory.
7. Put away all tools not being used and keep the floor clear of hazards.
8. Never set the blade to project more than an inch below the thickness being cut.
9. Never attempt to stop a saw by jamming it into the stock.
10. If anything unusual happens, turn off the power tool and report it to the instructor.
11. Do not lower the saw or set it aside until its blade has stopped rotating.

**Assignment Sheet #4**

Evaluated according to the stated criteria. Use this assignment to discuss each person's responsibility for environmental problems. Reducing waste is one thing that everyone can do.

# PEOPLE, TECHNOLOGY, AND THE ENVIRONMENT
## UNIT A-2

## TEST

Name ______________________________ Score __________________

1. Match the terms on the right with the correct definitions.

______a. State or condition of being safe and free from danger, risk, or injury

______b. Any sudden, unintentional event which causes personal injury or damage

______c. Immediate, temporary care given an accident victim until services of a physician can be obtained

______d. Projecting possible future outcomes of a given system or situation and analyzing the effects of each

______e. To transform waste products into new products

______f. Useless, unwanted, or discarded material

______g. A reduction in the quality of the environment by the introduction of impurities

______h. Poisonous; hazardous to plant and animal life even at very low concentrations

______i. Planned management of a natural resource which minimizes waste and maintains that resource for future use

______j. A source of wealth or revenue supplied by nature and used by humans

1. Accident
2. Biodegradable
3. Consequences
4. Conservation
5. Ecosystem
6. Environment
7. First aid
8. Futuring
9. Natural resources
10. Pollution
11. Recycle
12. Safety
13. Toxic
14. Waste

2. Discuss the interrelationship between people, technology, and the environment.

______________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

## TEST

3. Distinguish among the types of environmental pollution by placing the following letters next to the correct descriptions:

- A — Air pollution
- L — Land pollution
- W — Water pollution

______a. From automobile exhaust, industrial emissions, dust, and smoke

______b. From domestic sewage entering waterways before proper treatment, and industrial waste improperly disposed of in landfills that moves down into the groundwater

______c. From pesticides, toxic waste, acid rain, and disposal of solid waste

4. List two environmental conservation activities for each of the following areas.

a. Air conservation

1) ______________________________

2) ______________________________

b. Water conservation

1) ______________________________

2) ______________________________

c. Soil conservation

1) ______________________________

2) ______________________________

d. Energy conservation

1) ______________________________

2) ______________________________

5. Distinguish between recyclables and nonrecyclables by placing an "X" next to the recyclables.

______a. Glass

______b. Aluminum

______c. Leaves, grass

______d. Waste contaminated with food residue

# TEST

______e. Plastics

______f. Wood

______g. Paper

______h. Composite materials

______i. Furniture

______j. Street sweepings

6. Select true statements concerning general laboratory safety rules by placing an "X" in the appropriate blanks.

______a. Keep aisles and doorways cluttered.

______b. Turn off power before leaving machines and remain at machine until it comes to a stop.

______c. Use tools and equipment for any reason.

______d. It is not necessary to ask permission to use machines or tools.

______e. Report any defective tools or equipment to instructor.

______f. Use your hand to clean chips from a machine.

______g. Tools may be put any place in the laboratory.

______h. It is not necessary to clean up spilled liquid.

______i. Do not get involved in any horseplay.

______j. You may use machines unsupervised if your instructor will only be away from the room about 10 minutes.

7. Complete the following statements concerning personal safety rules by circling the correct words.

a. Use (soap and water, lotion) frequently as a method of preventing skin irritations.

b. (Approved safety glasses, Any glasses) can save your eyesight.

c. (Safety glasses, Face shields) are required when welding.

d. Remove (glasses, jewelry) when working in the laboratory.

## TEST

8. Match the futuring techniques on the right with the correct descriptions.

______a. Start with a central idea and expand the idea outward forming a wheel

______b. Identify several possible futures and what the combined results may be

______c. A survey conducted among experts to identify the most likely futures. The survey consists of listing and ranking possible futures

______d. Forecasting the future based upon past actions

1. Cross-impact analysis
2. Delphi survey
3. Future histories
4. Futures wheel
5. Trend analysis

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

9. Complete a parent communique about safety. (Assignment Sheet #1)

10. Survey the laboratory and identify correct safety practices. (Assignment Sheet #2)

11. Identify safety violations. (Assignment Sheet #3)

12. Complete a household inventory sheet. (Assignment Sheet #4)

# PEOPLE, TECHNOLOGY, AND THE ENVIRONMENT
## UNIT A-2

## ANSWERS TO TEST

1. a. 12
   b. 1
   c. 7
   d. 8
   e. 11
   f. 14
   g. 10
   h. 13
   i. 4
   j. 9

2. Discussion should include the following: (students may also give examples)

   a. Technology satisfies the needs and wants of people.
   b. People use technology to control their environment.
   c. The environment can be damaged by people and their use of technology.

3. a. A
   b. W
   c. L

4. Any two for each of the following:

   a. Air conservation

      1) Since cars are major air polluters, keep cars tuned up, change fuel filters often, maintain emission control devices, and use unleaded gasoline.
      2) Drive less, ride more. Use mass-transit, carpools, bicycles, or walk to work or school.
      3) Avoid using toxic chemicals released into the air such as oven cleaners and window cleaners. Instead use water and soap, baking soda, or vinegar.
      4) Plant trees. These use carbon dioxide and produce oxygen. Trees also help to purify the air.

   b. Water conservation

      1) Use low-flow shower heads. Short showers also use less water than baths.
      2) Use faucet aerators for each sink.
      3) Run washing machines and dishwashers only when they are full.
      4) Do not let faucets run while hand-washing dishes or brushing teeth.
      5) Water plants and lawns only as needed, and only in the morning to reduce evaporation.
      6) Fix leaky faucets or toilets.

## ANSWERS TO TEST

c. Soil conservation

    1) Keep soil covered with grass, ground covers, trees, and plants to prevent erosion.
    2) Reduce waste that would normally go to the landfill by recycling as much as possible and by buying products made from recycled materials.
    3) Do not send toxic substances such as oil, pesticides, or batteries to the municipal landfill.

d. Energy conservation

    1) Seal leaks and cracks around doors and windows with caulking and weather stripping.
    2) Increase the insulation in your home to the maximum recommendation.
    3) Drive fuel-efficient vehicles.
    4) Use mass-transit, carpools, bicycles, or walk.
    5) Set hot water heat at 120°F.
    6) Use a cooler wash and cooler rinse in washing machines.
    7) Turn down the heater at night.
    8) Use fluorescent lights instead of incandescent.
    9) Turn lights and TV off when not using them.
    10) Check for leaks around the refrigerator door. Also check the temperature. Set at 38°-42°.
    11) Use high-efficiency appliances and those with energy-saving features.
    12) Use microwave ovens and pressure cookers. They use less energy as well as save time.
    13) Use alternative energies (solar, wind) where possible to lessen demand on nonrenewable energies (fossil fuels).
    14) Use products that are recycled, recyclable, repairable, refillable, reusable, and long-lasting.

5. a, b, c, e, f, g

6. b, e, i

7.
    a. Soap and water
    b. Approved safety glasses
    c. Face shields
    d. Jewelry

8.
    a. 4
    b. 1
    c. 2
    d. 5

9-12. Evaluated to the satisfaction of the instructor

# INTRODUCTION TO COMMUNICATION
## UNIT B-1

## UNIT OBJECTIVE

After completion of this unit, the student should be able to identify elements of communication, research about communication devices and careers, and establish a communication organization. Competencies will be demonstrated by completing the assignment sheets, lab activity sheet, and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to communication with the correct definitions.
2. Match eras of history with the correct communication inventions.
3. Select from a list the purposes of communication.
4. Identify the elements of communication.
5. Identify steps in the communication process.
6. Match parts of the communication system model with the correct functions.
7. List ways to communicate.
8. Distinguish among the types of communication.
9. Discuss the impact of communication technology.
10. Discuss the interrelationships between communication and the other technology systems.
11. List careers in communication.
12. Research a communication device and discuss its future. (Assignment Sheet #1)
13. Research a communication career. (Assignment Sheet #2)
14. Send a message in a unique manner. (Assignment Sheet #3)
15. Establish a communication organization to produce a product or service. (Assignment Sheet #4)
16. Develop a telephone simulator. (Lab Activity Sheet #1)

## INTRODUCTION TO COMMUNICATION
## UNIT B-1

### SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher edition only and are designed to be used with the following objectives:

TM 1 — Communication Time Line — Objective 2

TM 2 — Steps in the Communication Process — Objective 5

TM 3 — Communication System Model — Objective 6

TM 4 — Ways to Communicate — Objective 7

TM 5 — Types of Communication — Objective 8

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information, assignment, and lab activity sheets.

F. Discuss information, assignment, and lab activity sheets.

(NOTE: Use the transparencies to reinforce content.)

G. Integrate the following activities throughout the teaching of this unit:

1. Use Teacher Supplement #1 to present AIT video B-1. This video was developed by the Agency for Instructional Technology (AIT) and a consortium of states to accompany this publication. Contact your state supervisor of technology education for copies, or contact AIT directly for more information:

Agency for Instructional Technology (AIT)
Box A, Bloomington, IN 47402
800-457-4509 or 812-339-2203

2. Use Teacher Supplements #2 and #3 to help students understand this unit's terminology. Make copies (fronts only) for your students. The answers are on the backs of the supplements.

## SUGGESTED ACTIVITIES

3. Invite professionals from all areas of communication to visit with your students.

   Examples: Commercial artists, photographers, drafters and CADD operators, writers and editors, journalists, etc.

4. Have students find pictures of different ways people use communication technology in communicating with each other. Make a display.

5. Give students guidance in project selection for Assignment Sheet #4. Select a project that will give the students a broad range of experience with communication technology and how it relates to the technical world. If possible, plan to create profit and goodwill for your department with the project.

6. Plan to integrate student organization activities and events into your communication curriculum. The TSA competitive events guidelines may be followed.

7. Collect communication devices and have students arrange them chronologically according to a timeline of when they were invented.

8. Demonstrate classroom equipment that will be used in communication technology.

9. Give a demonstration of interference by using a laser or radio signal.

10. Have students send messages through different communication devices.

11. Start an interdisciplinary activity such as having students create a message in language arts class and send it in the technology education class.

12. Have students role-play interviewing for a job and filling out job applications.

13. Have students play the "gossip" game. Discuss why a message changes.

14. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Administer test.

I. Evaluate test.

J. Reteach if necessary.

## REFERENCES USED IN DEVELOPING THIS UNIT

A. *TSA Competitive Events Guidelines*. Reston, VA: Technology Student Association, 1989.

B. Jones, Ronald E. and Janet L. Robb. *Discovering Technology Communication*. Dallas, TX: Harcourt Brace Jovanovich Publishers, 1986.

## SUGGESTED ACTIVITIES

C. Hacker, Michael and Robert Barden. *Living with Technology.* Albany, NY: Delmar Publishers, Inc., 1988.

D. Barden, Robert and Michael Hacker. *Communication Technology.* Albany, NY: Delmar Publishers, Inc., 1990.

E. DuVall, J. Barry, et. al. *Getting the Message: The Technology of Communication.* Worcester, MA: Davis Publications, Inc., 1981.

F. Richard D. Seymour, et. al. *Exploring Communications.* South Holland, IL: Goodheart-Willcox, 1987.

G. Barnes, Bruce. *An Introduction to Communications.* Mound, MN: Theta Industrial Products, Inc., 1989.

## SUGGESTED SUPPLEMENTAL RESOURCES

A. *Communication Technology Learning Activity Packet,* #316A. Available from:

Curriculum Publications Clearinghouse
Western Illinois University
Horrabin Hall 46
Macomb, IL 61455
309-298-1917

B. *Information Revolution.* Available from:

Pitsco
P.O. Box 1328
Pittsburg, KS 66762
800-835-0686

C. Videotapes

1. *Communications: The Expanding World; You, Me, and Technology Series.* Available from:

   Delmar Publishers Inc.
   2 Computer Drive, West
   Box 15015
   Albany, NY 12212-5015
   800-347-7077

2. *Introduction to Communication, Unit B-1; Exploring Technology Education* Series. Available from:

   Agency for Instructional Technology
   Box A
   Bloomington, IN 47402
   800-457-4509

# INTRODUCTION TO COMMUNICATION
## UNIT B-1

## TEACHER SUPPLEMENT #1—USING AIT VIDEO B-1

### Introduction and Program Summary (16:51)

This program introduces communication technology—its system components, devices, technological advances, and relationship to other technology systems. It focuses on the impact of communication technology throughout history, as people seek to communicate further and faster to conquer space and time.

Defining communication as the process of sending and receiving a message, the program opens with images of Buster Keaton trying to talk to a horse, a teenager with a Walkman®, and astronauts walking on the moon. The narrator explains that communication can link us all together. A blind and deaf woman communicates with a companion using an electronic braillewriter. All communication is founded on a systems model: sender, message, receiver, and a feedback loop.

The program then rapidly reviews technological progress in communication through history. Images and humorous sequences show how primitive cave drawings, hieroglyphics, clay tablets, and hand-copied manuscripts gave way to printing when Gutenberg started using movable type. The transmission of messages across distances improved rapidly in the last 150 years, with the development of the Morse telegraph, the transatlantic cable, the Bell telephone, the Marconi wireless telegraph, the phonograph, radio, and television. Satellite transmission, mobile phones, and the computer, using modems and electronic bulletin boards, further enhance the earlier technologies. The narrator reviews the systems model that shapes even the most advanced of these technologies, and mentions other communication devices, such as radio-controlled explosives, computer-assisted drafting, air traffic control, and computer-enhanced aerial photography. The program concludes with a look at communication technologies of the future—now being developed at MIT's Media Lab—and the Voyager space probe.

### Video Program Objectives

The video program will illustrate that

- communication follows a systems model (sender, message, receiver, and feedback loop)
- the technology of communication systems is evolving at a rapid pace
- advances in the construction, manufacturing, energy, power, and transportation sectors influence advances in communication systems

### Before the Program

1. Tell your students this lesson introduces communication technology and its importance to us. Technological advances permit people to communicate more and more efficiently. Everyone has been affected by these changes. Point to a telephone or a radio, and ask students how each has affected us. What if they had never been invented or developed? What do they have in common? What makes these "communication devices"?

## TEACHER SUPPLEMENT #1

2. Ask students to name other examples of communication. To prod them, ask why cars stop at some intersections and not others. Help them understand that stop signs and signal lights are communication devices. Tell students to look for examples of the three different types of communication in the video program: person to person, person to machine, and machine to machine.

3. Tell students what they will be doing in the lab, and how the content of the video program will set the stage for the laboratory activity.

4. Tell students to note the following in the video program: the systems model; people who have advanced communication technology and what they have done; the connections between communication systems and other technologies; the effect of developments in communication technology on people.

5. Tell students to listen for the following terms. (You might write them on the chalkboard.)

   communication
   communication technology
   communication satellite
   electronic bulletin boards
   telegraph
   Morse code
   movable type
   microchips
   holograms
   mobile telephone

**After the Program: Questions for Discussion and Review**

1. What is communication? *(the process of sending and receiving a message)*

2. What are the main purposes for communication? *(to inform, to persuade, to control tools and machines, to entertain, to educate)*

3. List some of the ways people communicate. *(speech, pictures, writing, signals)*

4. What are examples of person-to-person communication devices? *(letters, telephone calls)* Person to machine? *(computer keyboard, robot controls)* Machine to machine? *(computers linked by modems)* (You could list student responses under the appropriate heading written on the chalkboard.)

5. What are the terms associated with the communication system model? *(sender, message, receiver, feedback)*

6. Describe the telephone and the microcomputer in terms of the universal systems model (input, process, output, feedback). *(**Telephone:** The **input** involves the sounds of the voice entering the telephone receiver. The **process** involves the transmission of the sounds over wires. The **output** is the sound of the voice issuing from another receiver into a listener's ear. The **feedback** is the response of the person hearing the first voice speak, sending a message back to the first speaker. **Microcomputer:** The **input** is the data entered at the keyboard. The **process** is the way the computer controls data and converts instructions into actions—calculations, spellcheck, etc. The **output** may be a picture, graphic, or words on a screen, a synthesized sound, or directions to another machine to move or switch on or off. The **feedback** is the signals verifying that the ordered action occurred or that there were problems.)*

## TEACHER SUPPLEMENT #1

7. How has technology affected the way we communicate? *(A single message can be replicated or broadcast to reach countless numbers of receivers. It can also be transmitted almost instantaneously over vast distances.)*

8. How have advances in other technology systems affected communication technology? *The manufacture of fiberoptics, computer chips, and satellites helped transmit messages further and more efficiently. The development of the rocket permitted the launching of communication satellites. Electricity powers radios, televisions, and word processors.)*

# INTRODUCTION TO COMMUNICATION
## UNIT B-1

## TEACHER SUPPLEMENT #2—CROSSWORD PUZZLE

Name ________________________________ Date __________________

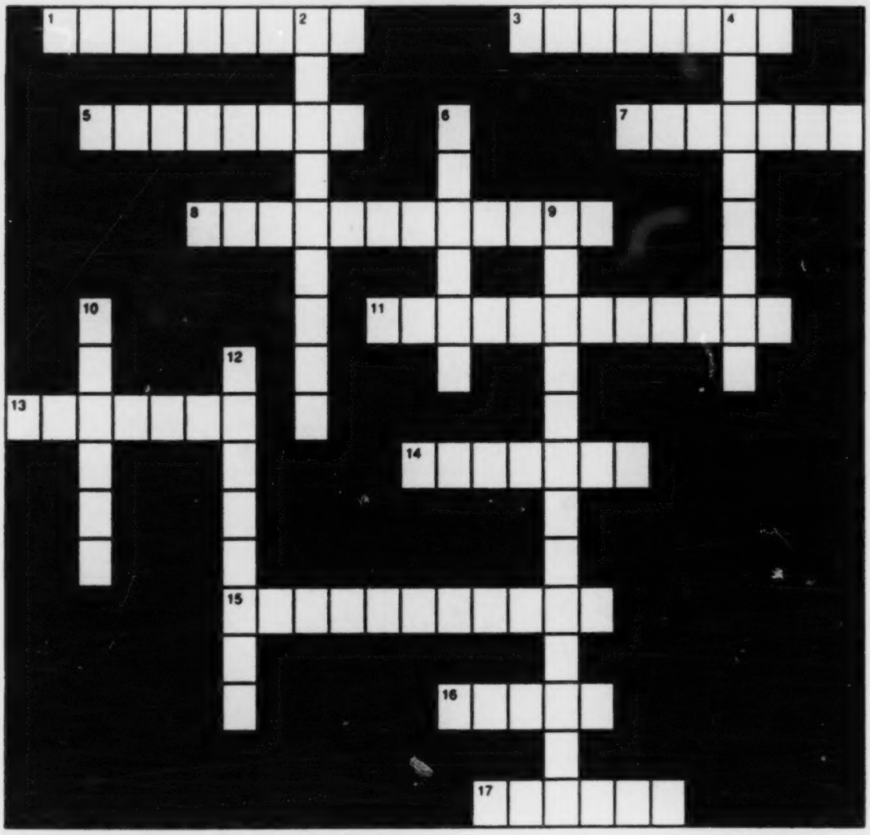
Directions: Use the clues below to solve the crossword puzzle.

ACROSS:

1. Accepting the message
3. One who accepts a message
5. To understand and respond to the message
7. Steps of developing the message
8. Noise
11. Sending the message
13. Anything that is communicated
14. The means through which a message is sent
15. Based on our sense of sight and hearing
16. Based on our sense of hearing
17. Any one or thing that sends a message

DOWN:

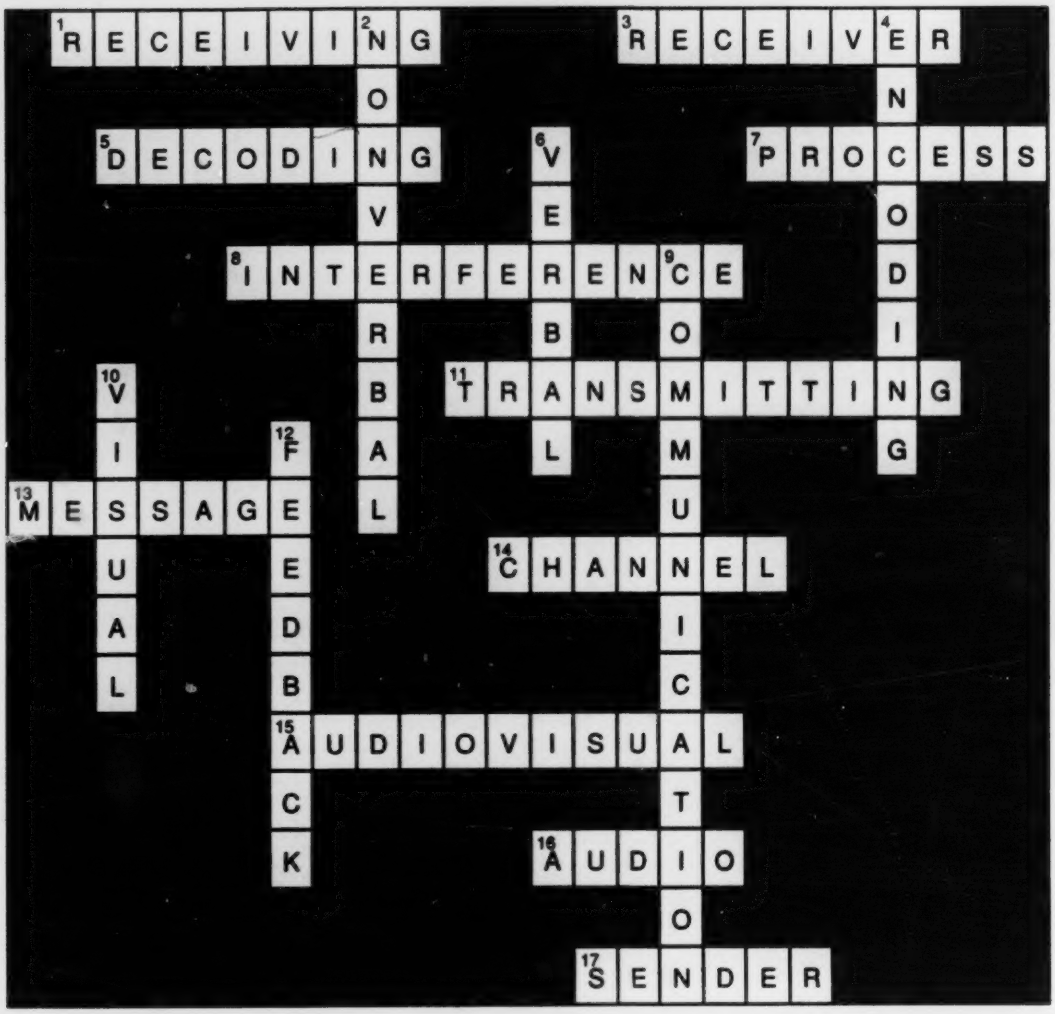
2. Gestures, smells, touches, etc.
4. Preparing the message
6. Speeches, memos, letters, etc.
9. The process of sending and receiving a message
10. Based on our sense of sight
12. The reaction of the receiver



*Duplication Permitted*

## TEACHER SUPPLEMENT #2

## CROSSWORD PUZZLE ANSWER KEY


1 RECEIVING
2 NONVERBAL
3 RECEIVER
4 ENCODING
5 DECODING
6 VERBAL
7 PROCESS
8 INTERFERENCE
9 COMMUNICATION
10 VISUAL
11 TRANSMITTING
12 FEEDBACK
13 MESSAGE
14 CHANNEL
15 AUDIOVISUAL
16 AUDIO
17 SENDER

## INTRODUCTION TO COMMUNICATION
## UNIT B-1

### TEACHER SUPPLEMENT #3—WORD SEARCH

Name ______________________________ Date ________________

Directions: Find the words below hidden in the puzzle. Circle the words that you find.

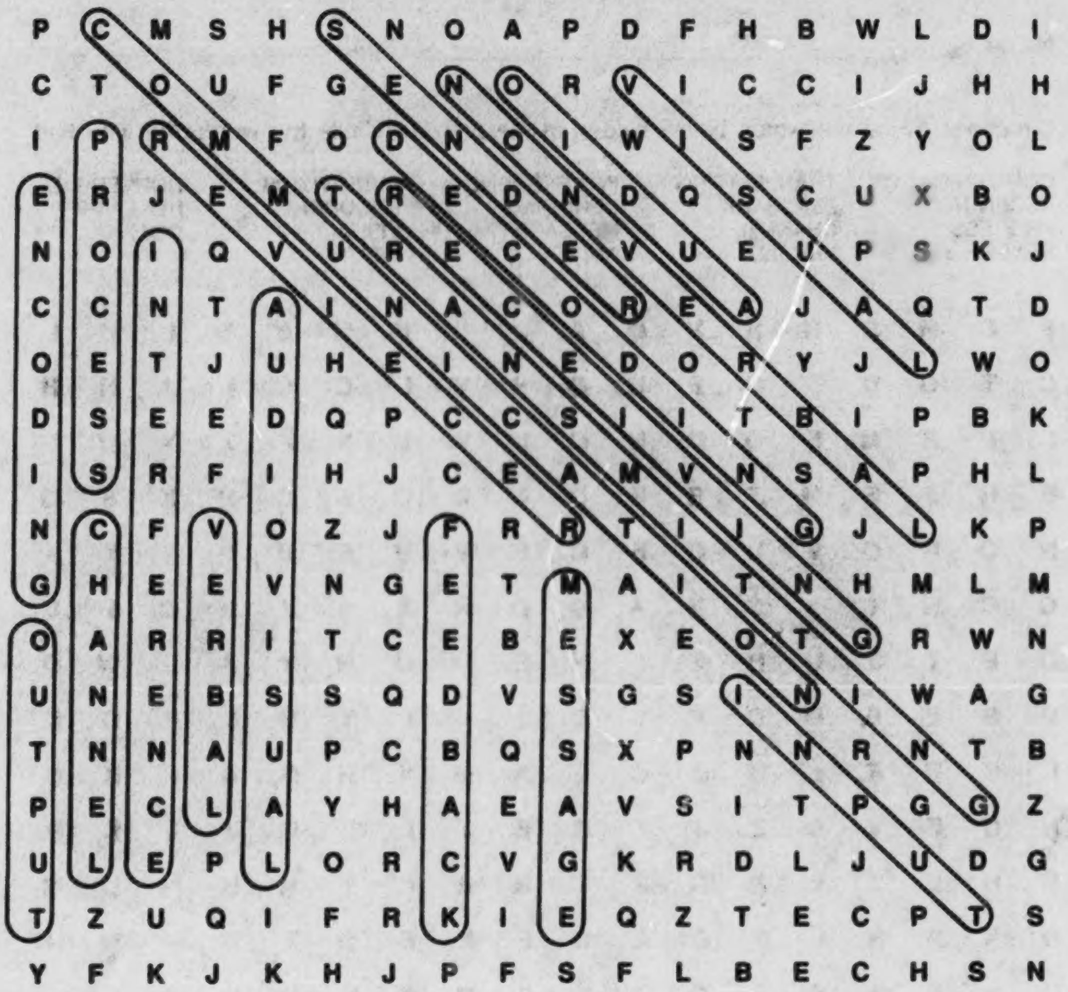
COMMUNICATION
RECEIVING
PROCESS
SENDER
TRANSMITTING
FEEDBACK
CHANNEL
VERBAL
INTERFERENCE
DECODING
MESSAGE
AUDIO
AUDIOVISUAL
ENCODING
VISUAL
INPUT
NONVERBAL
RECEIVER
OUTPUT

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P | C | M | S | H | S | N | O | A | P | D | F | H | B | W | L | D | I |
| C | T | O | U | F | G | E | N | O | R | V | I | C | C | I | J | H | H |
| I | P | R | M | F | O | D | N | O | I | W | I | S | F | Z | Y | O | L |
| E | R | J | E | M | T | R | E | D | N | D | Q | S | C | U | X | B | O |
| N | O | I | Q | V | U | R | E | C | E | V | U | E | U | P | S | K | J |
| C | C | N | T | A | I | N | A | C | O | R | E | A | J | A | [illegible] | T | D |
| O | E | T | J | U | H | E | I | N | E | D | O | R | Y | J | L | W | O |
| D | S | E | E | D | Q | P | C | C | S | I | I | T | B | I | P | B | K |
| I | S | R | F | I | H | J | C | E | A | M | V | N | S | A | P | H | L |
| N | C | F | V | O | Z | J | F | R | R | T | I | I | G | J | L | K | P |
| G | H | E | E | V | N | G | E | T | M | A | I | T | N | H | M | L | M |
| O | A | R | R | I | T | C | E | B | E | X | E | O | T | G | R | W | N |
| U | N | E | B | S | S | Q | D | V | S | G | S | I | N | I | W | A | G |
| T | N | N | A | U | P | C | B | Q | S | X | P | N | N | R | N | T | B |
| P | E | C | L | A | Y | H | A | E | A | V | S | I | T | P | G | G | Z |
| U | L | E | P | L | O | R | C | V | G | K | R | D | L | J | U | D | G |
| T | Z | U | Q | I | F | R | K | I | E | Q | Z | T | E | C | P | T | S |
| Y | F | K | J | K | H | J | P | F | S | F | L | B | E | C | H | S | N |

*Duplication Permitted*

## TEACHER SUPPLEMENT #3

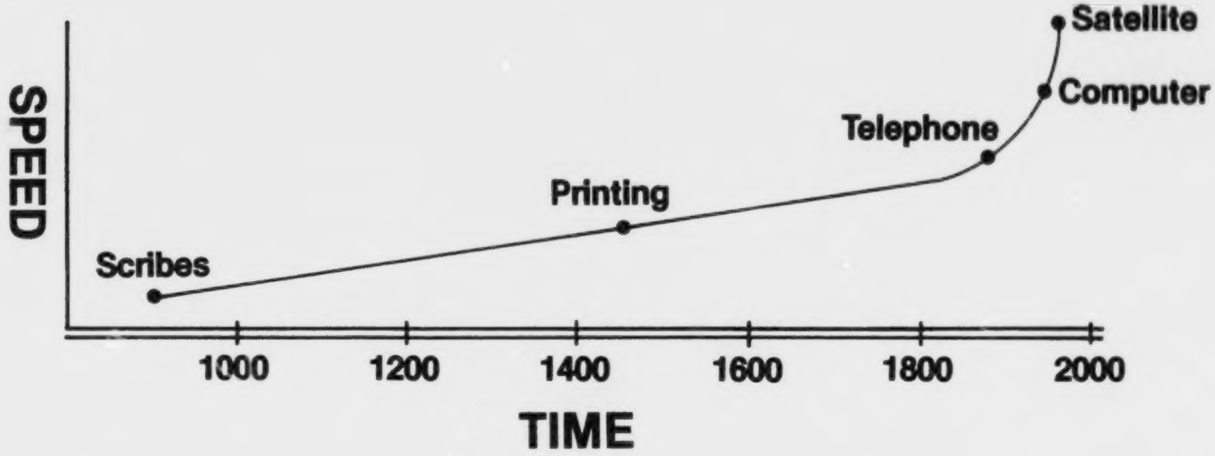
## WORD SEARCH ANSWER KEY



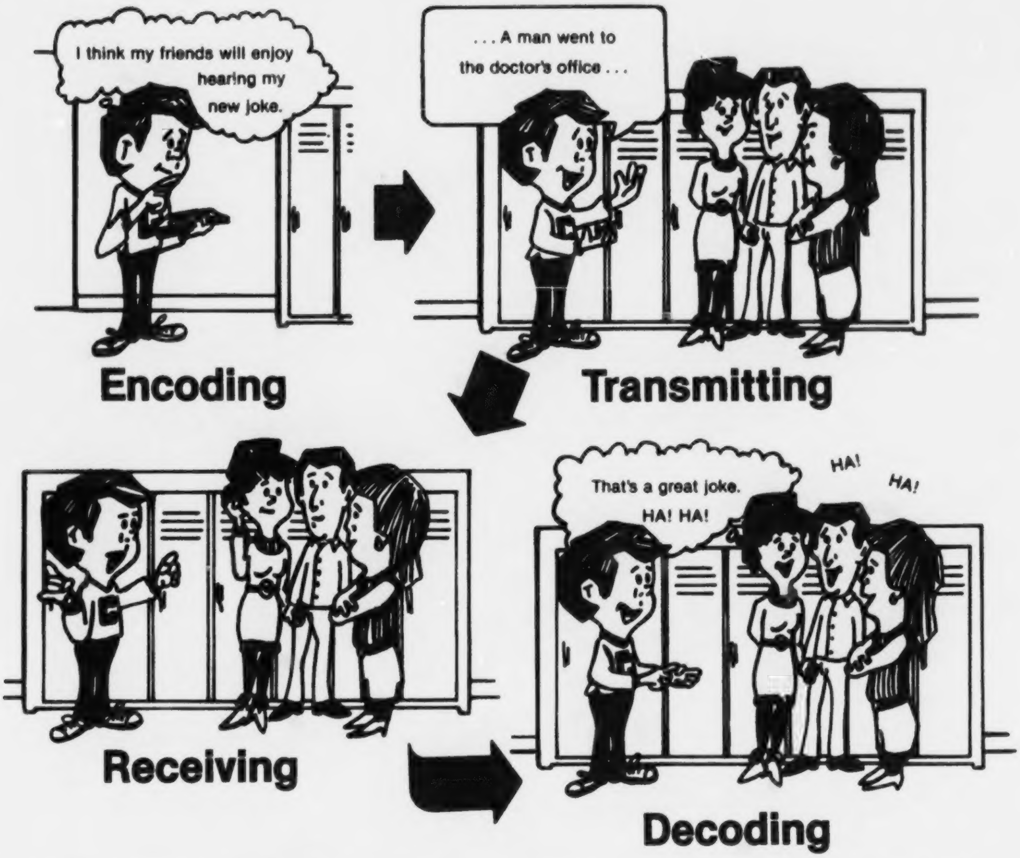
| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P | C | M | S | H | S | N | O | A | P | D | F | H | B | W | L | D | I |
| C | T | O | U | F | G | E | N | O | R | V | I | C | C | I | J | H | H |
| I | P | R | M | F | O | D | N | O | I | W | J | S | F | Z | Y | O | L |
| E | R | J | E | M | T | R | E | D | N | D | Q | S | C | U | X | B | O |
| N | O | I | Q | V | U | R | E | C | E | V | U | E | U | P | S | K | J |
| C | C | N | T | A | I | N | A | C | O | R | E | A | J | A | Q | T | D |
| O | E | T | J | U | H | E | I | N | E | D | O | R | Y | J | L | W | O |
| D | S | E | E | D | Q | P | C | C | S | I | I | T | B | I | P | B | K |
| I | S | R | F | I | H | J | C | E | A | M | V | N | S | A | P | H | L |
| N | C | F | V | O | Z | J | F | R | R | T | I | J | G | J | L | K | P |
| G | H | E | E | V | N | G | E | T | M | A | I | T | N | H | M | L | M |
| O | A | R | R | I | T | C | E | B | E | X | E | O | T | G | R | W | N |
| U | N | E | B | S | S | Q | D | V | S | G | S | I | N | I | W | A | G |
| T | N | N | A | U | P | C | B | Q | S | X | P | N | N | R | N | T | B |
| P | E | C | L | A | Y | H | A | E | A | V | S | I | T | P | G | G | Z |
| U | L | E | P | L | O | R | C | V | G | K | R | D | L | J | U | D | G |
| T | Z | U | Q | I | F | R | K | I | E | Q | Z | T | E | C | P | T | S |
| Y | F | K | J | K | H | J | P | F | S | F | L | B | E | C | H | S | N |

# Communication Time Line

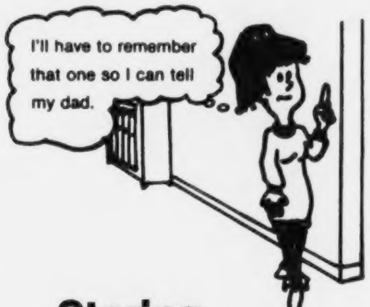
Advances in communication technology create more efficient systems resulting in increased speed of communication.



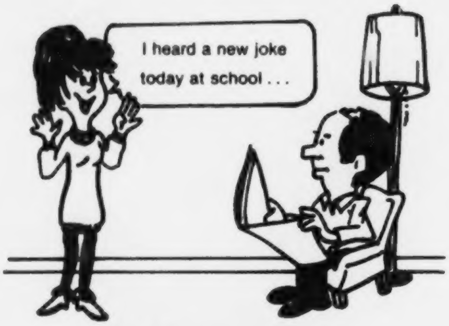
# Steps in the Communication Process


I think my friends will enjoy hearing my new joke.
Encoding
. . . A man went to the doctor's office . . .
Transmitting
Receiving
That's a great joke. HA! HA!
HA!
HA!
Decoding

Storing and Retrieving allow the same message to be repeated.

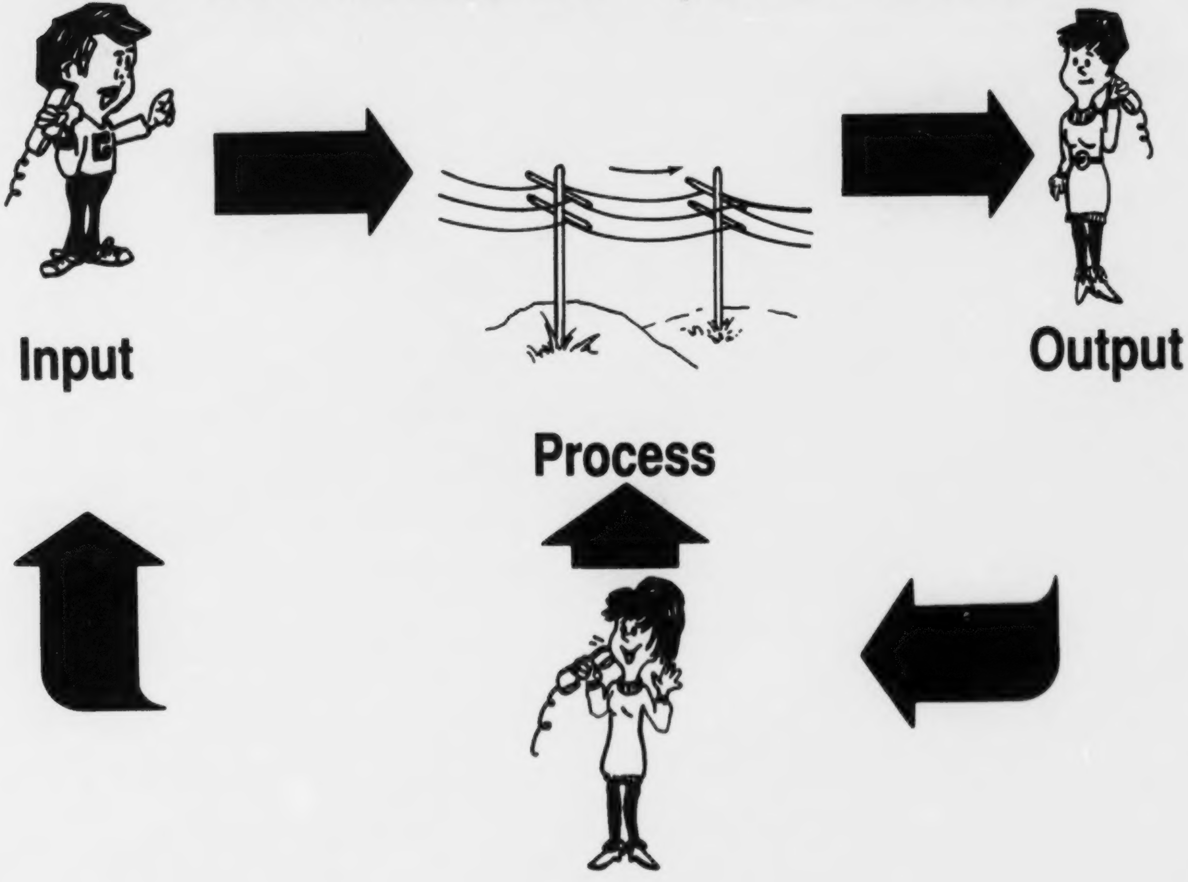

I'll have to remember that one so I can tell my dad.

**Storing**


I heard a new joke today at school . . .

**Retrieving**

# Communication System Model



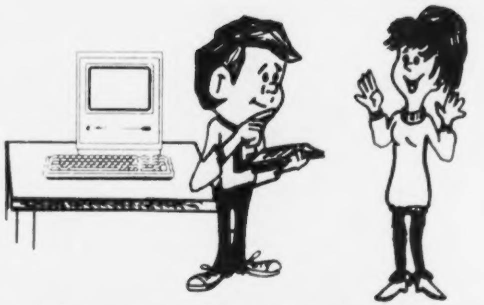
Input

Process

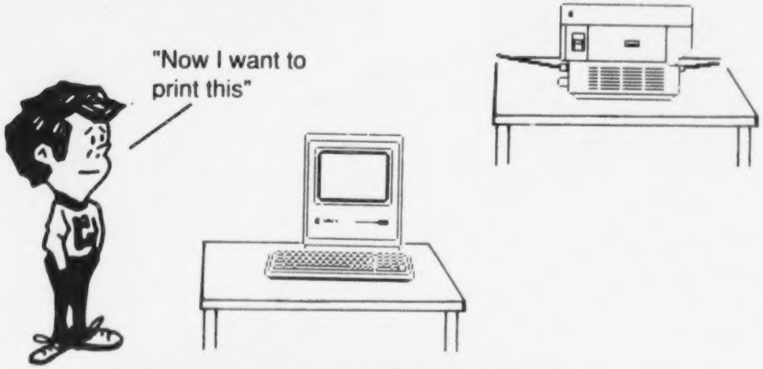
Output

Feedback

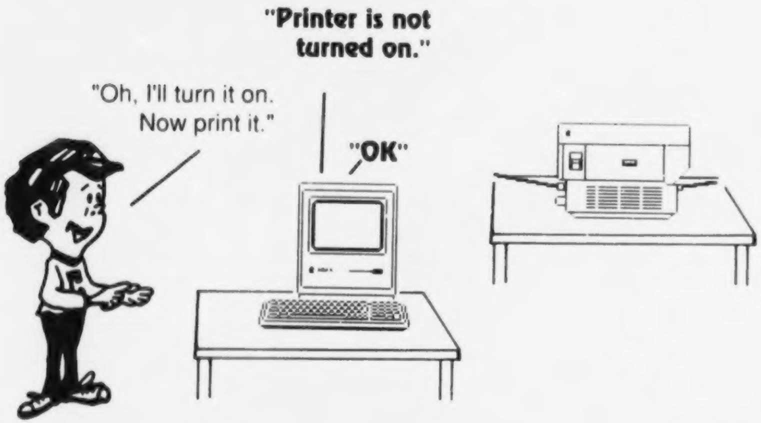
# Ways to Communicate



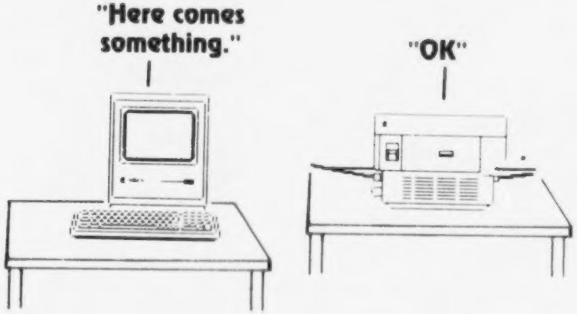
**Human to Human**


"Now I want to print this"

**Human to Machine**

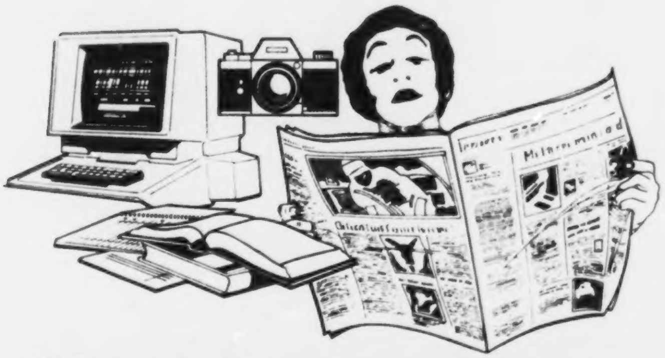

"Oh, I'll turn it on. Now print it."
"Printer is not turned on."
"OK"

**Machine to Human**

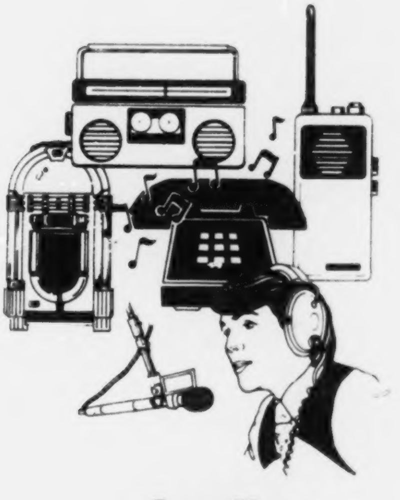

"Here comes something."
"OK"

**Machine to Machine**

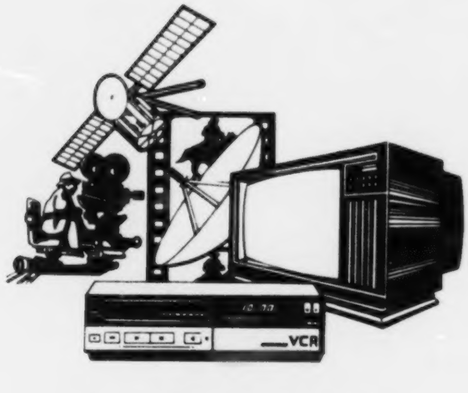
# Types of Communication



Visual Communication



Audio Communication



Audiovisual Communication

# INTRODUCTION TO COMMUNICATION
## UNIT B-1

## INFORMATION SHEET

I. **Terms and definitions**

A. Communication — The process of sending and receiving a message; uses a common system of words, symbols, signs, or behavior

B. Communication technology — Tools, materials, and processes that people use to enhance their ability to communicate

C. Interference — Anything that keeps a message from being communicated clearly; noise

D. Nonverbal communication — Exchanging information through signs, symbols, or behavior without the use of words

Examples: Gestures, smells, touches, traffic light

E. Telecommunication — Exchanging information over a distance through the use of electronics

Examples: Telegraph, radio, television, computers

F. Verbal communication — Using words as a means of exchanging information

Examples: Speeches, letters, memos

II. **Development of communication technology**

(NOTE: As human beings evolved, they developed the ability to communicate through oral speech. Later, additional methods of communication were developed.)

**A.** **Agricultural Era** — Methods of communication became visual and more permanent. Examples of communication during this era include:

- Cave pictures (early people, 15,000 B.C.)
- Hieroglyphics (Egyptians, 3,000 B.C.)
- Greek and Roman alphabets

**B.** **Industrial Era** — Methods of communication became more advanced and mechanized. Many communication devices and machines were invented. Examples include:

- Photography (1839)
- Telegraph (Samuel F. B. Morse, 1843)
- Telephone (Alexander Graham Bell, 1876)

## INFORMATION SHEET

- Camera with rolled film (George Eastman, 1888)
- Radio (Marconi, 1901)
- Television (1926)
- Computer (Mark I, 1944)

C. **Information Era** — Methods of communication became faster and more efficient, primarily because of computer assistance. Several examples include:

- Integrated circuit (Texas Instruments, 1958)
- Laser (Theodore Maiman, 1960)
- Satellite (USA, 1962)
- Microprocessor (Intel, 1971)
- Fiberoptics (1970's)
- Home computer (Apple, 1976)
- Video camera (1984)
- Desktop publishing (1984)

III. **Purposes of communication**

A. To inform

B. To persuade

C. To control tools and machines

D. To entertain

E. To educate

IV. **Elements of communication**

A. Sender — Any one or thing that sends a message.

B. Message — Any communication between sender and receiver.

C. Channel — The means through which a message is sent.

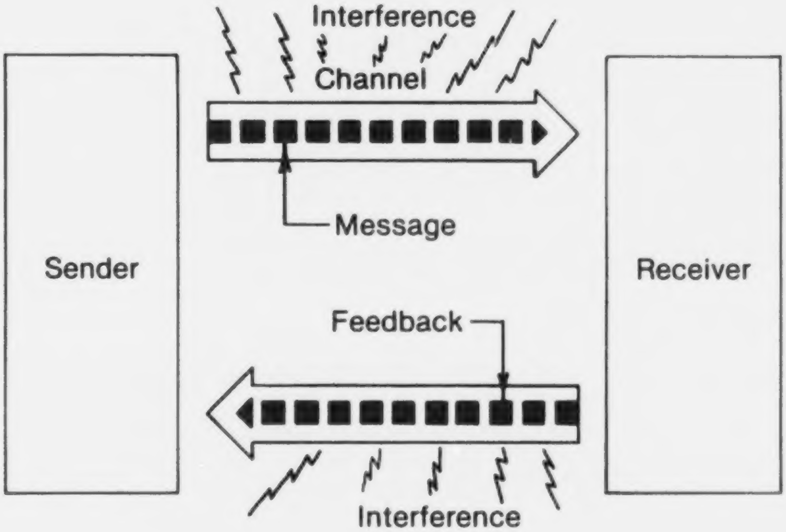
D. Interference — Anything that prevents a message from being communicated clearly; noise.

## INFORMATION SHEET

E. Receiver — One who gets a message.

F. Feedback — The reaction or reply one has to a message.

(NOTE: This is necessary to evaluate the effectiveness of the message.)



V. **Steps of the communication process**

(NOTE: Successful communication depends on both the sender and the receiver understanding the communication process. The four steps listed can be entered at any point, but no steps can be omitted without causing a breakdown in communication.)

A. Encoding — Preparing a message that a person receiving the message will understand

Examples: Perceiving, comprehending, symbolizing, organizing, valuing

B. Transmitting — After the sender encodes the message, he or she sends it to the receiver through some means.

Examples: Gesturing, touching, speaking, drawing, writing

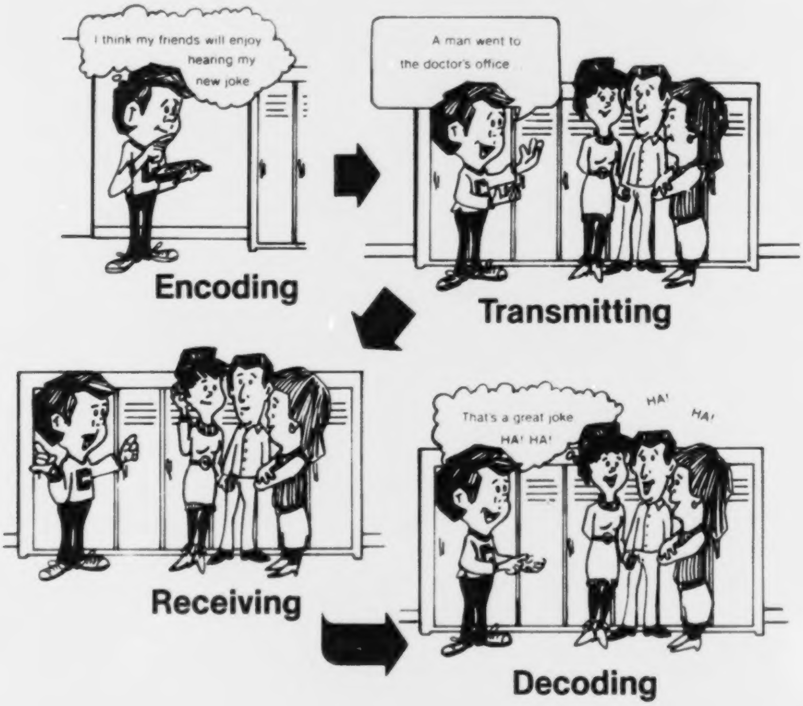
C. Receiving — Takes place when a person accepts a message and is able to recognize its symbols. The five basic senses are used to receive messages.

Examples: Seeing, hearing, feeling, smelling, tasting

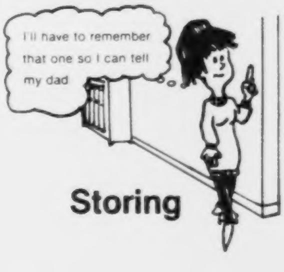
## INFORMATION SHEET

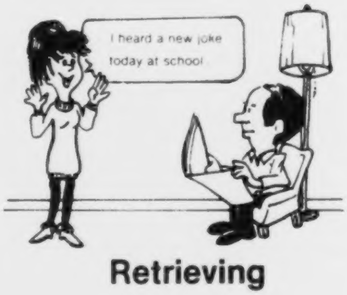
D. Decoding — To understand and respond to the message

Examples: Perceiving, interpreting, synthesizing, responding


I think my friends will enjoy hearing my new joke
Encoding
A man went to the doctor's office
Transmitting
Receiving
That's a great joke HA! HA!
HA!
HA!
Decoding

(NOTE: Once a message has gone through the communication process, it can be forgotten or stored in a memory. To recall a message it must be retrieved from your memory bank. Storing and retrieving a message allows it to be repeated.)


I'll have to remember that one so I can tell my dad
Storing


I heard a new joke today at school
Retrieving

## INFORMATION SHEET

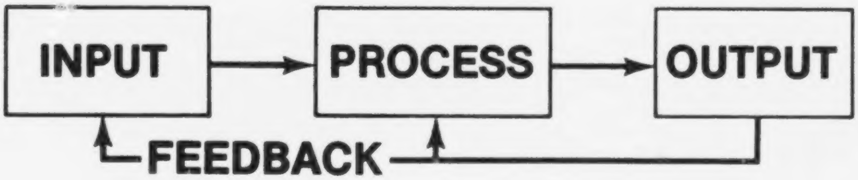
VI. **Parts of the communication system model**

A. Input — Sender gathers necessary resources to develop a message.

B. Process — Sender uses equipment and material to process information.

C. Output — Completed message is sent to receiver.

D. Feedback — Reaction of the receiver. Often the feedback is returned to the sender.



VII. **Ways to communicate**

A. Human to human

Example: People talking

B. Human to machine

Example: Person programming a computer

C. Machine to human

Example: Computer asking if you want to save current data

D. Machine to machine

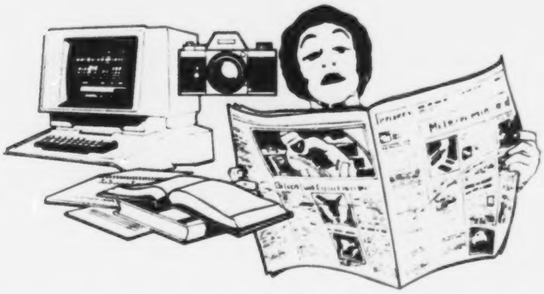
Example: CPU sending electronic signals to printer

## INFORMATION SHEET

### VIII. Types of communication

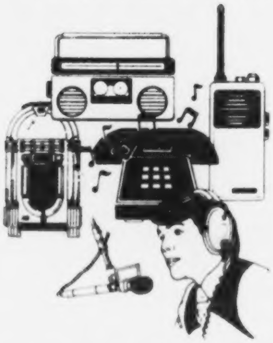
A. Visual communication — Based on our sense of sight.

Examples: Drawings, newspapers, books



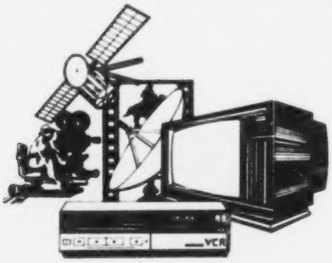
B. Audio communication — Based on our sense of hearing.

Examples: Telephones, stereos, tape recorders



C. Audiovisual communication — Combines visual and audio messages.

Examples: Movies, television



## INFORMATION SHEET

### IX. Impact of communication technology

A. **Families** experience the impact of communication technology through the stock market report in the daily newspaper, listening to the latest recording on the radio, or watching the day's events on a television newscast. Buying an advertised product or receiving a telephone call is also an effect of communication.

B. **Governments** could not operate today without communication. Communication serves at all levels of government: local, state, and national. Government leaders and journalists keep us informed through the media.

C. **International** events are telecast worldwide almost immediately. Military conflicts, disasters, and political and social events become public information daily. Television and satellite transmission has linked the nations of the world and brought millions entertainment and information.

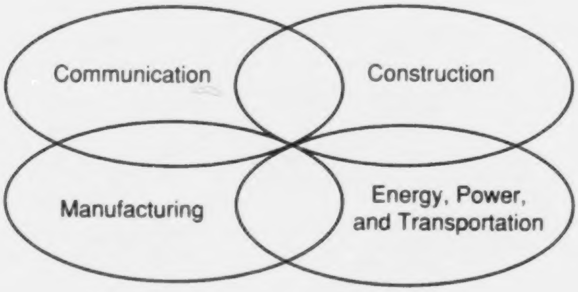
D. **Industrial/commercial businesses** use communication technology each day to communicate with their employees and to promote their business and products with consumers. The use of computers has increased productivity and in some cases has improved employee safety.

### X. Interrelationships between communication and the other technology systems

A. **Construction** — Uses blueprints, written specifications, oral communication between workers, hand signals at the work site, and specialized communication equipment in order to construct buildings and other structures. Many of these buildings are for communication companies.

B. **Manufacturing** — Uses assembly drawings, research information and statistics, flow charts, customer surveys, oral communication between workers, and computer-aided machines to produce products for consumers. Many of these products are devices for communication.

C. **Energy, power, and transportation** — Uses instrument gauges, radar, sonar, traffic signs, and many computerized instruments to monitor its systems and processes. Energy, power, and transportation provides electricity required by communication systems and devices. Rockets also place satellites in orbit for use in communication.



## INFORMATION SHEET

XI. **Careers in communication**

A. Commercial art and design
   1. Designer
   2. Artist/illustrator

B. Engineering drafting and design
   1. Designer
   2. Drafter
   3. CADD operator

C. Printing
   1. Camera operator/platemaker
   2. Press operator
   3. Bindery worker

D. Print journalism and publishing (books, magazines, newspapers)
   1. Writer
   2. Editor
   3. Reporter
   4. Photographer

E. Films and broadcasting (news, entertainment, and educational)
   1. Writer
   2. Director
   3. Producer
   4. Announcer
   5. Actor/actress
   6. Programmer
   7. Camera operator
   8. Technician (audio, lighting, etc.)

# INFORMATION SHEET

F. Fine arts — Theater, music, literature, visual art
    1. Producer
    2. Director
    3. Actor/actress
    4. Technician (audio, lighting, etc.)
    5. Musician
    6. Composer
    7. Writer
    8. Artist/painter
    9. Sculptor

G. Telecommunication operators and technicians — Computer, telephone, satellite, etc.

## INTRODUCTION TO COMMUNICATION
## UNIT B-1

## ASSIGNMENT SHEET #1 — RESEARCH A COMMUNICATION DEVICE AND DISCUSS ITS FUTURE

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Research is thorough and accurate | ______ |
| Assignment is neat and completed on time | ______ |

Directions: Select a communication device such as a video tape recorder, telephone system, microcomputer, computer-aided drafting system, printing process, camera, or any other communication device. Give some information on its effect on society today and discuss how it could affect the future generation. The research information should include history, current status, and effect on the future. Record your information below.

Name of communication device — ____________________

Date device was invented or discovered — ____________________

History— ________________________________________

________________________________________

________________________________________

________________________________________

Current— ________________________________________
Status

________________________________________

________________________________________

________________________________________

________________________________________

Future— ________________________________________

________________________________________

________________________________________

________________________________________

## INTRODUCTION TO COMMUNICATION
## UNIT B-1

## ASSIGNMENT SHEET #2—RESEARCH A COMMUNICATION CAREER

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Research is thorough and accurate | ______ |
| Report is in correct format | ______ |
| Assignment is neat and completed on time | ______ |

Directions: Examples of careers in the communication field were discussed in the Information Sheet. You may be able to name other careers also. Select a career you think you would be good in. Research for more details.

1. What is the exact training needed?
2. Where can you get that training?
3. What are the working conditions for that job?
4. What are the future possibilities of employment?
5. Why would you be good at that job?

Compile the results of your research and present it either in written or oral form as requested by your instructor.

A written research paper should include the following:

- Title page
- Table of contents
- Introduction
- Review of literature (body)
- Conclusion
- Endnotes/footnotes (if applicable)

## INTRODUCTION TO COMMUNICATION
## UNIT B-1

### ASSIGNMENT SHEET #3 — SEND A MESSAGE IN A UNIQUE MANNER

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Message is sent in unique manner | ________ |
| Message is transmitted well | ________ |
| Assignment is neat and completed on time | ________ |

Directions: Select a unique and appropriate way to send a message to some one or thing.

Examples: You want a job.
You must dismiss someone from a job.
You want a date with someone.
You want to tell a parent something.

Describe the message and the way you transmitted it below. ______________

How did the receiver respond to the message (feedback)? ______________

## INTRODUCTION TO COMMUNICATION
## UNIT B-1

### ASSIGNMENT SHEET #4—ESTABLISH A COMMUNICATION ORGANIZATION TO PRODUCE A PRODUCT OR SERVICE

Name ______________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Communication product or service is appropriate | ______ |
| Management system is established and jobs are assigned | ______ |
| Report is neat and completed on time | ______ |

Directions: Work as a group or as directed by your instructor and decide on the type of organization to be established. Report your decisions to your instructor. Use the following steps.

A. Select a communication area.

Examples: Printing, photography, drafting, telecommunication, computer-aided design, desktop publishing

(NOTE: Factors to consider in selection are what facilities are available in your laboratory. Follow instructor's directions for selection.)

B. Generate capital.

Examples: Sell product or service in advance, sell stock, use school funds

C. Establish management system and make job assignments.

(NOTE: This involves setting up organizational structure, assigning personnel positions, and acquiring facilities and equipment.)

D. Develop product or service idea.

(NOTE: Use problem-solving techniques to decide what product or service will be used as the class project.)

## INTRODUCTION TO COMMUNICATION
## UNIT B-1

### LAB ACTIVITY SHEET #1—DEVELOP A TELEPHONE SIMULATOR

Name ________________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Followed steps correctly | ________ |
| Good quality product | ________ |

A. Equipment and supplies:

1. Tin cans, 2
2. Copper wire (string) — 50-100 feet
3. Finish nails, 3
4. Hammer

B. Rules and regulations:

1. Wear safety glasses.
2. Take turns using the telephone simulator.

C. Procedure: (Requires 2 people to complete)

1. Clean each tin can.
2. Use nail and hammer to make a hole in the center of each can's end.
3. Place one end of wire through hole in one can and attach to a finish nail.
4. Place other end of wire through hole in other can and attach to the other finish nail.
5. Have each lab partner hold one can and walk apart until wire (string) is taut (not slack).
6. Take turns talking and listening.
7. Answer the following questions.

## LAB ACTIVITY SHEET #1

D. Questions:

1. What are the key elements in communicating with the telephone simulator?

2. How could you improve the telephone simulator?

## INTRODUCTION TO COMMUNICATION
## UNIT B-1

## TEST

Name ______________________________ Score ________________

1. Match the terms on the right with the correct definitions.

_____a. Using words as a means of exchanging information

_____b. Exchanging information through signs, symbols, or behavior without the use of words

_____c. Anything that keeps a message from being communicated clearly; noise

_____d. Exchanging information over a distance through the use of electronics

_____e. The process of sending and receiving messages; uses common system of words, symbols, signs, or behavior

_____f. Tools, materials, and processes that people use to enhance their ability to communicate

1. Communication
2. Communication technology
3. Interference
4. Nonverbal communication
5. Telecommunication
6. Verbal communication
7. Visual communication

2. Match the eras on the right with the correct communication inventions.

_____a. Telephone

_____b. Hieroglyphics

_____c. Satellite

_____d. Greek and Roman alphabets

_____e. Home computer

_____f. Camera with rolled film

_____g. Radio

_____h. Telegraph

_____i. Fiberoptics

_____j. Laser

1. Agricultural era
2. Industrial era
3. Information era

# TEST

3. Select from the following list the purposes of communication by placing an "X" in the appropriate blanks.

_____a. To educate

_____b. To inform

_____c. To deceive

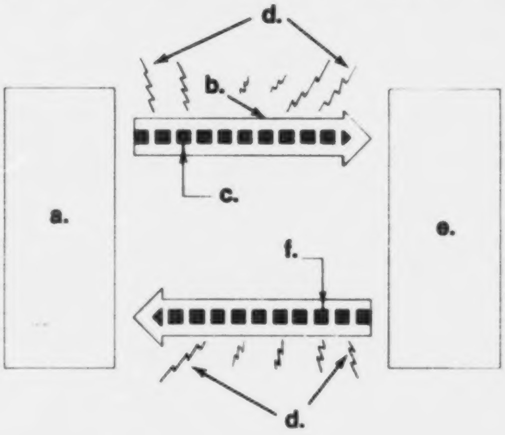
_____d. To entertain

_____e. To control tools and machines

_____f. To make products

_____g. To persuade

4. Identify the elements of communication by filling in the blanks below.



a. ____________________

b. ____________________

c. ____________________

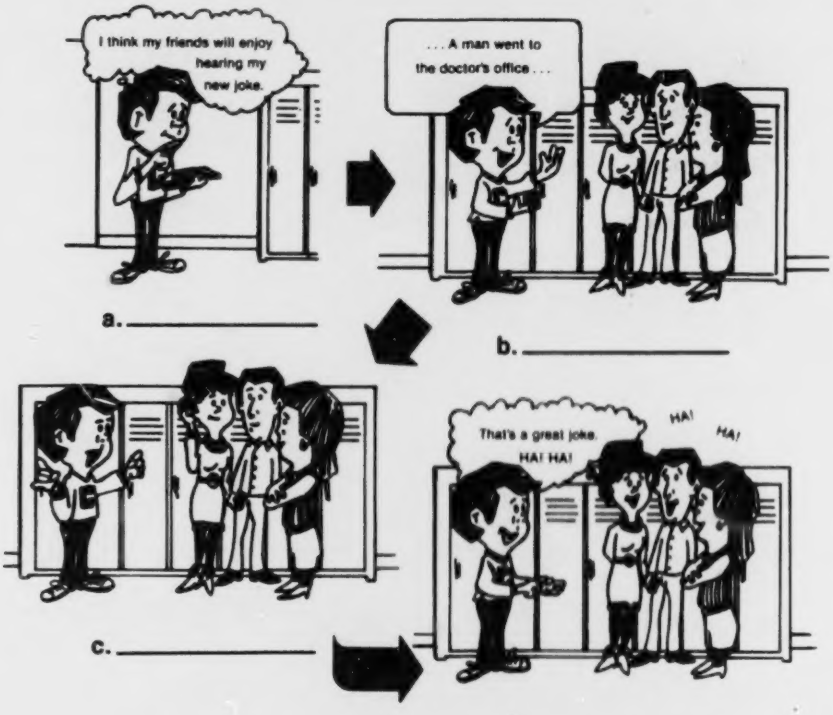
d. ____________________

e. ____________________

f. ____________________

## TEST

5. Identify the steps in the communication process by writing the following words in the correct blanks: Decoding, encoding, receiving, transmitting.


I think my friends will enjoy hearing my new joke.
. . . A man went to the doctor's office . . .
That's a great joke. HA! HA!
HA!
HA!

a. ______________

b. ______________

c. ______________

d. ______________

6. Match parts of the communication system model with the correct definitions.

| | | | |
|---|---|---|---|
| _____a. | Completed message is sent to receiver | 1. | Development |
| _____b. | Reaction of the receiver | 2. | Feedback |
| _____c. | Sender gathers necessary resources to develop a message | 3. | Input |
| | | 4. | Output |
| _____d. | Sender uses equipment and material to process information | 5. | Process |

7. List two ways to communicate: Example: Human to human

a. ______________________

b. ______________________

## TEST

8. Distinguish among the types of communication by placing the following letters next to the appropriate examples:

V—Visual
A—Audio
AV—Audiovisual

_____a. Television

_____b. Stereo record players

_____c. Newspapers

_____d. Drawings

_____e. Tape recorders

_____f. Movies

_____g. Telephones

_____h. Books

9. Discuss the impact of communication technology on the following areas of our society:

a. Families—______________________________

______________________________

b. Governments—______________________________

______________________________

10. Discuss the interrelationships between communication and the other technology systems.

a. Construction— ______________________________

______________________________

______________________________

b. Manufacturing — ______________________________

______________________________

______________________________

## TEST

c. Energy, power, and transportation — ______________________________

11. List eight careers in communication.

    a. ______________________________

    b. ______________________________

    c. ______________________________

    d. ______________________________

    e. ______________________________

    f. ______________________________

    g. ______________________________

    h. ______________________________

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

12. Research a communication device and discuss its future. (Assignment Sheet #1)

13. Research a communication career. (Assignment Sheet #2)

14. Send a message in a unique manner. (Assignment Sheet #3)

15. Establish a communication organization to produce a product or service. (Assignment Sheet #4)

16. Develop a telephone simulator. (Lab Activity Sheet #1)

## INTRODUCTION TO COMMUNICATION
## UNIT B-1

## ANSWERS TO TEST

1. a. 6
   b. 4
   c. 3
   d. 5
   e. 1
   f. 2

2. a. 2
   b. 1
   c. 3
   d. 1
   e. 3
   f. 2
   g. 2
   h. 2
   i. 3
   j. 3

3. a, b, d, e, g

4. a. Sender
   b. Channel
   c. Message
   d. Interference
   e. Receiver
   f. Feedback

5. a. Encoding
   b. Transmitting
   c. Receiving
   d. Decoding

6. a. 4
   b. 2
   c. 3
   d. 5

7. Any two of the following:

   a. Human to machine
   b. Machine to human
   c. Machine to machine

8. a. AV
   b. A
   c. V
   d. V
   e. A
   f. AV
   g. A
   h. V

## ANSWERS TO TEST

9. Answers should be evaluated to the satisfaction of the instructor. Student's discussion should include information of a similar nature to the following:

   a. **Families** experience the impact of communication technology through the stock market report in the daily newspaper, listening to the latest recording on the radio, or watching the day's events on a television newscast. Buying an advertised product or receiving a telephone call is also an effect of communication.

   b. **Governments** could not operate today without communication. Communication serves at all levels of government: local, state, and national. Government leaders and journalists keep us informed through the media.

10. Answers should be evaluated to the satisfaction of the instructor. Student's discussion should include information of a similar nature to the following:

    **Construction** — Uses blueprints written specifications, oral communication between workers, hand signals at the work site, and specialized communication equipment in order to construct buildings and other structures. Many of these buildings are for communication companies.

    **Manufacturing** — Uses assembly drawings, research information and statistics, flow charts, customer surveys, oral communication between workers, and computer-aided machines to produce products for consumers. Many of these products are devices for communication.

    **Energy, power, and transportation** — Uses instrument gauges, radar, sonar, traffic signs, and many computerized instruments to monitor its systems and processes. Energy, power, and transportation provides electricity required by communication systems and devices. Rockets also place satellites in orbit for use in communication.

11. Any eight of the following:

    a. Designer
    b. Artist/illustrator
    c. Drafter
    d. CADD operator
    e. Camera operator/platemaker
    f. Press operator
    g. Bindery worker
    h. Writer
    i. Editor
    j. Reporter
    k. Photographer
    l. Director
    m. Producer
    n. Announcer
    o. Actor/actress
    p. Programmer
    q. Technician (audio, lighting, etc.)
    r. Musician

## ANSWERS TO TEST

s. Composer
t. Artist/painter
u. Sculptor
v. Telecommunication operators and technicians — Computer, telephone, satellite, etc.

12-16. Evaluated to the satisfaction of the instructor

# DESIGNING MESSAGES
## UNIT B-2

## UNIT OBJECTIVE

After completion of this unit, the student should be able to apply the elements and principles of design to prepare a preliminary message. Competencies will be demonstrated by completing the assignment sheets and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to designing messages with the correct definitions.
2. Arrange in order the steps in designing a message.
3. Complete statements concerning ways to design preliminary messages.
4. Match the elements of visual design with the correct descriptions.
5. Complete statements concerning the principles of visual design.
6. Match types of sketches with the correct descriptions.
7. List purposes of sketching.
8. Arrange in order the steps in sketching.
9. Match methods for audio and audiovisual designing with the correct descriptions.
10. Identify elements and principles of design. (Assignment Sheet #1)
11. Improve an advertisement. (Assignment Sheet #2)
12. Design a message. (Assignment Sheet #3)
13. Sketch objects. (Assignment Sheet #4)

# DESIGNING MESSAGES
## UNIT B-2

## SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher edition only and are designed to be used with the following objectives:

TM 1—Steps in Designing a Message—Objective 2
TM 2—Commercial/Graphic Art Sketches—Objective 6A
TM 3—Engineering/Drafting Sketches—Objective 6B
TM 4—Storyboard—Objective 9A
TM 5—Production Scripts—Objective 9B and C

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

G. Integrate the following activities throughout the teaching of this unit:

1. Plan to use this unit as the preliminary design unit prior to Unit B-3. The exploratory areas you may wish to use are:

   Drafting, printing, photography, reprographics, desktop publishing, radio, VCR, and computer-aided design

2. Use Teacher Supplement #1 to present AIT video B-2. This video was developed by the Agency for Instructional Technology (AIT) and a consortium of states to accompany this publication. Contact your state supervisor of technology education for copies, or contact AIT directly for more information:

   Agency for Instructional Technology (AIT)
   Box A, Bloomington, IN 47402
   800-457-4509 or 812-339-2203

3. Use Teacher Supplements #2 and #3 to help students understand this unit's terminology. Make copies (fronts only) for your students. The answers are on the backs of the supplements.

4. Implement the TSA competitive events Graphic Logo or Safety Poster as a design project.

## SUGGESTED ACTIVITIES

5. Use a resource of advertisements to supplement Assignment Sheet #2. Find ads that are poorly composed, lack unity, and emphasize the wrong points or elements. Use this assignment to point out the importance of correct lettering size, style, and unity.

6. Show advertisements or pictures that illustrate formal and informal balance. Have students discuss how to change from one style to the other.

7. Show examples of award-winning ads and have students discuss why they were selected as outstanding.

8. Develop individual modules for student activities and plan to rotate students through the system. All students cannot work on the same project at one time.

9. Use computer software in the design process. Several programs are listed in the "Suggested Supplemental Resources" on the following page. Many others are being developed and may be available from a local computer center.

10. Use package design as a design problem.
    a. Have each student choose a product or assign a product to be packaged.
    b. Analyze existing package designs. Discuss the strengths and weaknesses of the designs. Discuss why some packages appeal to a particular group of consumers.
    c. Discuss the environmental effects of packaging. Excess packaging should be discouraged.
    d. Ask your students to disassemble existing packages and produce development drawings of them in the following units.

11. Design a product label for a manufactured product from the manufacturing section.

12. Develop a video commercial for a commercial product (class project).

13. Design a storyboard and script for a production play.

14. Develop a script for a radio commercial (using cassette recorder).

15. Have students make pictorial sketches of actual objects in the classroom.

H. Administer test.

I. Evaluate test.

J. Reteach if necessary.

## SUGGESTED ACTIVITIES

## REFERENCES USED IN DEVELOPING THIS UNIT

A. Jones, Ronald E. and Janet L. Robb, *Discovering Technology Communication.* Dallas, TX: Harcourt Brace Jovanovich Publishers, 1986.

B. Bame, E. Allen and Paul Cumming. *Exploring Technology.* Worcester, MA: Davis Publishing, Inc., 1980.

C. Kagy, Frederick D. *Graphic Arts.* South Holland, IL: The Goodheart-Willcox Company, Inc., 1981.

D. Walker, John R. *Graphic Arts Fundamentals.* South Holland, IL: The Goodheart-Willcox Company, Inc., 1980.

E. *Graphic Communications.* Iowa High School Industrial Technology Curriculum Project. Iowa Department of Public Instruction, 1986.

## SUGGESTED SUPPLEMENTAL RESOURCES

A. Computer software programs

1. *Print Shop* — Simple to use. Writes, designs, and prints business cards, letterheads, notices, etc. Teaches layout technique. Has different type styles, borders, and clip art. Available for IBM, Apple II, Macintosh, and Apply family hardware.
2. *Newsroom* — Designs, produces, and prints newspapers. Has a large clip art library. Available for Apple II, Apple family, and IBM hardware.
3. *Computer Eyes II* — Creates real world images by hooking a video camera to a computer and digitizes the picture onto paper. Available for Apple II and IBM hardware.
4. *Printmaster* — Very similar to *Print Shop* program. Available for IBM and Apple.
5. *Publish It* — For design, layout, and printing of desktop publications such as newspapers and newsletters. Available for IBM and Apple.
6. *MACVision* — Video digitizing device which uses a radio signal and converts it to digits so the microcomputer can use or store it. The image can then be printed. Ideal for a type of screen printing. This is available from local software stores.

## SUGGESTED ACTIVITIES

B. Videotapes

1. *Designing Messages, Unit B-2; Exploring Technology Education* series. Available from:

   Agency for Instructional Technology
   Box A
   Bloomington, IN 47402
   800-457-4509

2. *Conceptualization and Copy Development.* 1982. 15 min. Color. Available from:

   Oberlin Color Press
   100 W. Airport Road
   Stillwater, OK 74074
   405-743-2840

3. *Communications: Graphic Systems*, #891.

4. *Communications: Film, Video, and Broadcast Systems*, #892.

   3 and 4 are available from:

   Bergwall Productions, Inc.
   P.O. Box 238
   Garden City, NY 11530-0238
   800-645-3565

# DESIGNING MESSAGES
## UNIT B-2

## TEACHER SUPPLEMENT #1—USING AIT VIDEO B-2

### Introduction and Program Summary (13:17)

This program is about designing an effective visual message. It presents the three steps for designing a message and demonstrates the elements of good design.

The narrator points out that a newspaper is a message, and must be carefully thought out. To design a newspaper, or any visual message, planners must consider **audience**—who it is and what it wants; **content**—its appropriateness to the targeted audience; and **form**, which involves such design elements as line, color, readability, balance, space, and unity.

The program visits the headquarters of *USA Today* to demonstrate how feedback from readers influences decisions of content and form. An editor, a weatherman, and two graphic designers discuss how they transform information into effective visual images. The narrator looks briefly at other publications and television programs to show how the same design considerations determine different formats for difference audiences. The program concludes by looking to the future, when an artificial intelligence system might make it possible for each of us to customize our own magazine for our own personal use.

### Video Program Objectives

The video program will illustrate that

- design considerations for any message include audience (who the message is for), content (what the message is), and form (how the message is to be presented)
- important design elements in the form of a visual message are line, color, readability, space, balance, and unity

### Before the Program

1. Tell your students this lesson introduces the general considerations for the design of any message.
2. Explain that several (but not all) of the elements in the design of a visual message will be discussed and illustrated.
3. Relate what the students will see in the program to the assignments and activities they will be doing in the lab.
4. Tell students that the following terms and careers will be mentioned in the video program. (You might write them on the chalkboard.)

## TEACHER SUPPLEMENT #1

**Terms**

readability
balance
space
graphics
color
unity
line
form

**Careers**

editor
weatherman
graphic designer
illustrator

### After the Program: Questions for Discussion and Review

1. What are the general considerations for the design of any message? (*audience, content, form*)
2. Show examples of magazines and ask, "Who is the intended audience? How does the content fit the audience? How does the style and form help reach this audience?"
3. Show examples of advertisements, and ask students to comment on the use of line, color, readability, balance, space, and unity.
4. How has technology affected the way we design messages? *(Computers help design graphics. Video technology permits such effects as superimposed images and time-lapse photography.)*

# DESIGNING MESSAGES
## UNIT B-2

## TEACHER SUPPLEMENT #2—CROSSWORD PUZZLE

Name ______________________________ Date ____________________

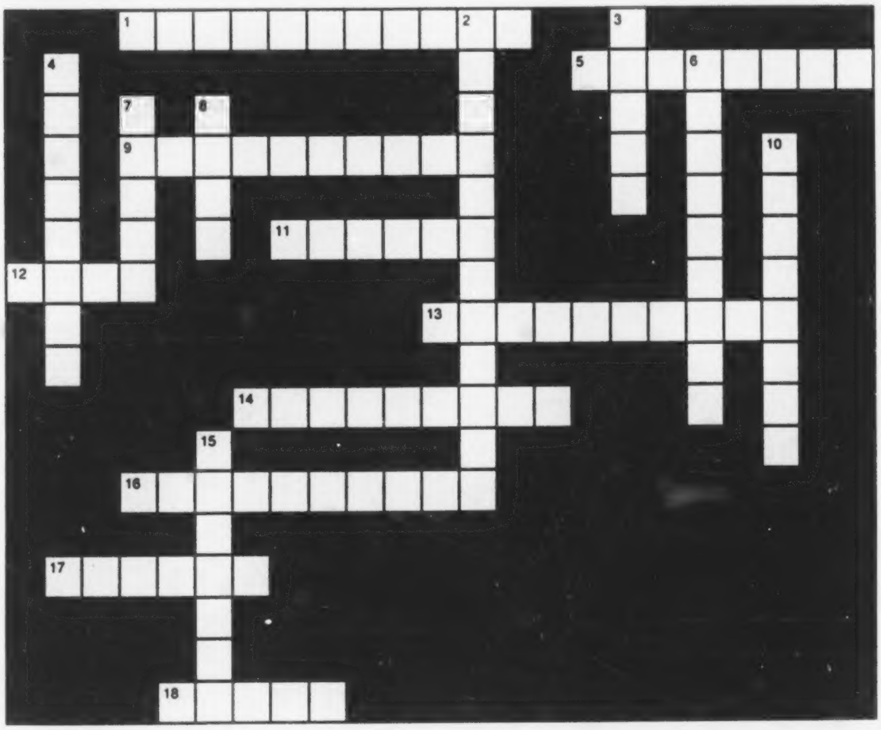
Directions: Use the clues below to solve the crossword puzzle.

ACROSS

1. Determined by how easily a message may be read
5. Used to create interest and attract attention
9. Relationship between the sizes of elements
11. Directs and controls the motion of reader's eye
12. Moves the reader's eye from one point to another
13. Outlines the program's action with graphics and words
14. Coming into possession of a message
16. A form of feedback to determine understanding
17. Specifies the media, style, and arrangement used
18. Means used for transmitting a message

DOWN

2. Transferring or sending a message
3. Attracts the eye and provides contrast
4. Converting information into a message
6. Type of sketch made quickly to show design ideas
7. The area allowed to work with
8. Gives an element shape
10. Understanding and responding to a message
15. Distribution of weight on each side of a center point



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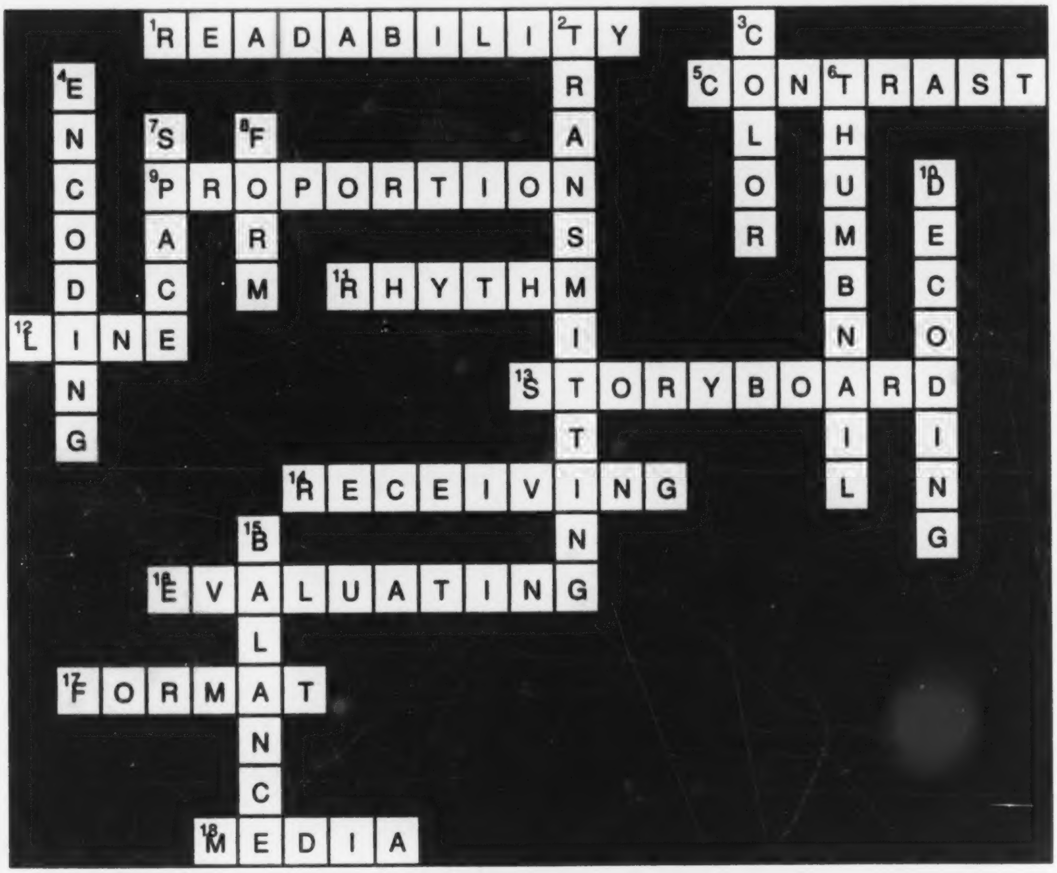
64-B

## TEACHER SUPPLEMENT #2

## CROSSWORD PUZZLE ANSWER KEY


1 READABILITY
2 TRANSMITTING
3 COLOR
4 ENCODING
5 CONTRAST
6 THUMBNAIL
7 SPACE
8 FORM
9 PROPORTION
10 DECODING
11 RHYTHM
12 LINE
13 STORYBOARD
14 RECEIVING
15 BALANCE
16 EVALUATING
17 FORMAT
18 MEDIA

## DESIGNING MESSAGES
## UNIT B-2

### TEACHER SUPPLEMENT #3—WORD SEARCH

Name ______________________________ Date ____________________

Directions: Find the words below hidden in the puzzle. Circle the words that you find.

TRANSMITTING
RECEIVING
BALANCE
COLOR
READABILITY
THUMBNAIL
FORMAT
UNITY
EVALUATING
DECODING
RHYTHM
LINE
PROPORTION
ENCODING
MEDIA
FORM
STORYBOARD
CONTRAST
SPACE

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S | Q | Y | T | I | N | U | D | E | C | O | D | I | N | G | U | X | V |
| A | L | T | H | U | M | B | N | A | I | L | Z | C | G | T | V | B | M |
| N | G | E | D | O | T | M | S | C | O | L | O | R | W | E | H | R | N |
| L | F | N | E | U | F | R | H | P | T | M | E | D | I | A | A | Q | C |
| P | U | O | I | E | S | T | A | T | A | I | P | B | J | F | G | J | S |
| R | R | H | R | D | V | T | M | N | Y | C | O | G | L | F | P | X | G |
| E | H | O | Y | M | O | A | O | R | S | H | E | W | Q | V | C | J | O |
| A | B | N | P | O | A | C | L | R | O | M | R | A | J | I | E | R | E |
| D | N | A | R | O | R | T | N | U | Y | F | I | J | I | N | Y | J | T |
| A | C | D | L | E | R | C | Y | E | A | B | M | T | Q | X | C | B | E |
| B | H | O | R | A | C | T | O | V | S | T | O | J | T | X | N | X | L |
| I | L | B | G | K | N | E | I | N | N | U | I | A | B | I | N | V | Q |
| L | L | N | V | Q | M | C | I | O | T | F | C | N | R | I | N | Z | H |
| I | W | K | V | L | T | T | E | V | N | R | U | A | G | D | H | G | F |
| T | R | F | C | I | E | K | G | T | I | O | A | U | K | N | L | Q | C |
| Y | M | O | T | N | Y | H | V | Z | G | N | Y | S | G | Q | S | T | D |
| N | F | A | B | E | K | B | I | H | X | C | G | F | T | X | M | L | Y |
| N | B | D | F | Y | M | I | U | Y | S | J | R | A | T | N | E | Y | Y |

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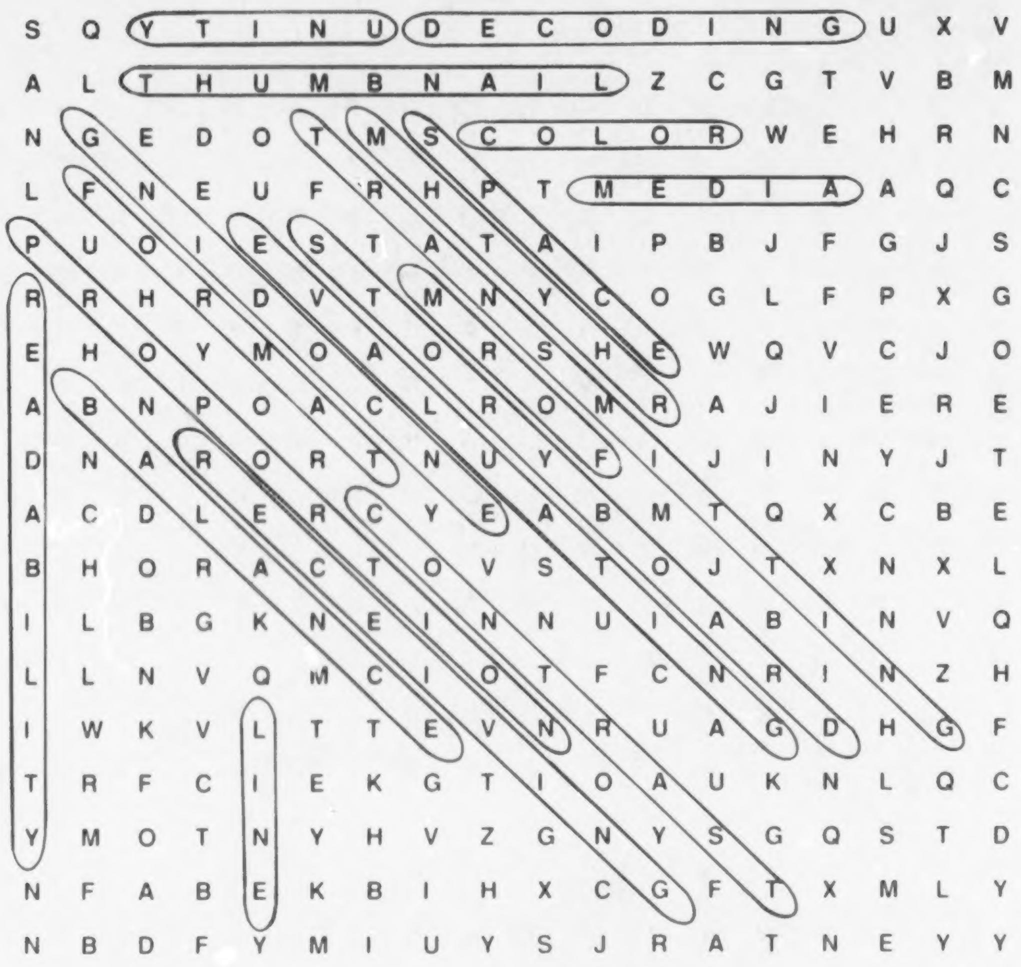
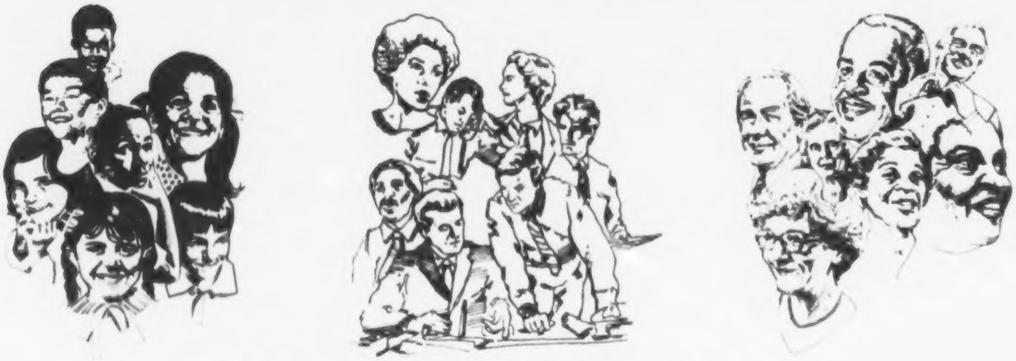
## TEACHER SUPPLEMENT #3

## WORD SEARCH ANSWER KEY

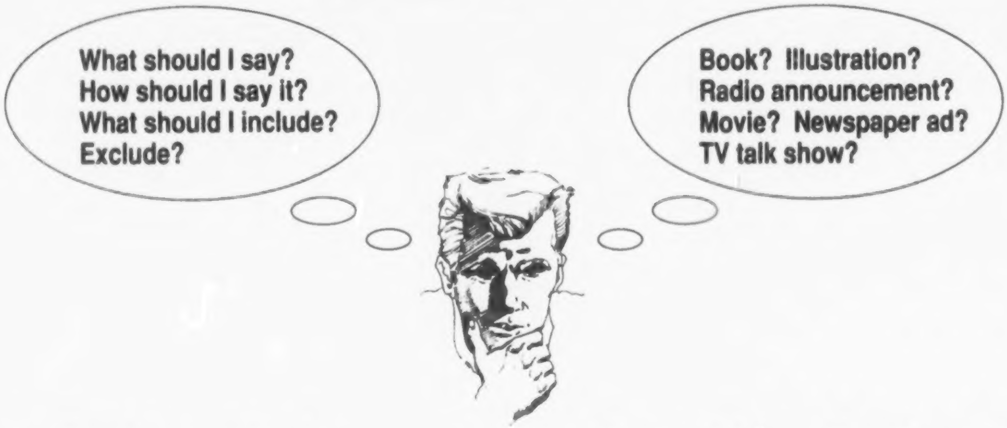


| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S | Q | Y | T | I | N | U | D | E | C | O | D | I | N | G | U | X | V |
| A | L | T | H | U | M | B | N | A | I | L | Z | C | G | T | V | B | M |
| N | G | E | D | O | T | M | S | C | O | L | O | R | W | E | H | R | N |
| L | F | N | E | U | F | R | H | P | T | M | E | D | I | A | A | Q | C |
| P | U | O | I | E | S | T | A | T | A | I | P | B | J | F | G | J | S |
| R | R | H | R | D | V | T | M | N | Y | C | O | G | L | F | P | X | G |
| E | H | O | Y | M | O | A | O | R | S | H | E | W | Q | V | C | J | O |
| A | B | N | P | O | A | C | L | R | O | M | R | A | J | I | E | R | E |
| D | N | A | R | O | R | T | N | U | Y | F | I | J | I | N | Y | J | T |
| A | C | D | L | E | R | C | Y | E | A | B | M | T | Q | X | C | B | E |
| B | H | O | R | A | C | T | O | V | S | T | O | J | T | X | N | X | L |
| I | L | B | G | K | N | E | I | N | N | U | I | A | B | I | N | V | Q |
| L | L | N | V | Q | M | C | I | O | T | F | C | N | R | I | N | Z | H |
| I | W | K | V | L | T | T | E | V | N | R | U | A | G | D | H | G | F |
| T | R | F | C | I | E | K | G | T | I | O | A | U | K | N | L | Q | C |
| Y | M | O | T | N | Y | H | V | Z | G | N | Y | S | G | Q | S | T | D |
| N | F | A | B | E | K | B | I | H | X | C | G | F | T | X | M | L | Y |
| N | B | D | F | Y | M | I | U | Y | S | J | R | A | T | N | E | Y | Y |

# Steps in Designing a Message



A. Determine the Audience.

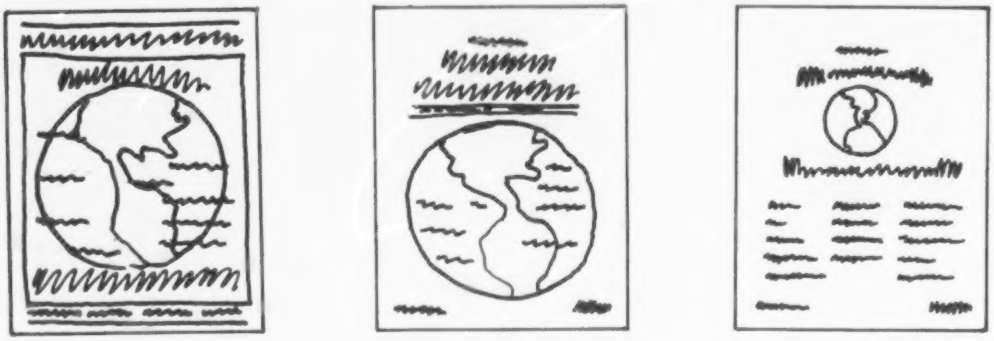

What should I say?
How should I say it?
What should I include?
Exclude?
Book? Illustration?
Radio announcement?
Movie? Newspaper ad?
TV talk show?

B. Decide on the Message Content.

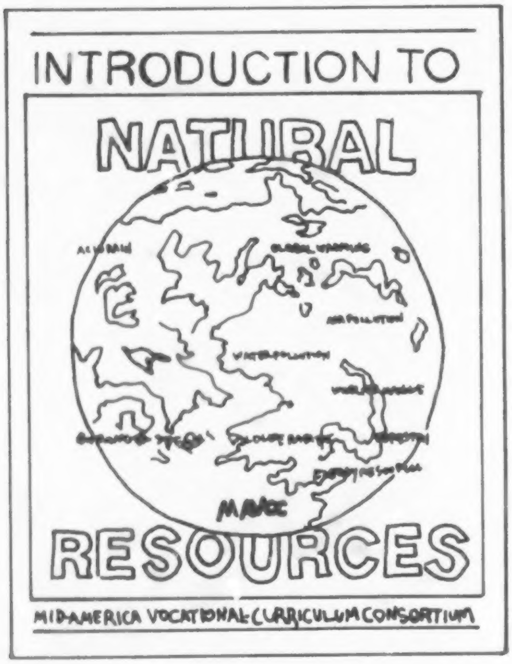
C. Decide on the Format.

D. Prepare Preliminary Message.

# Commercial/Graphic Art Sketches

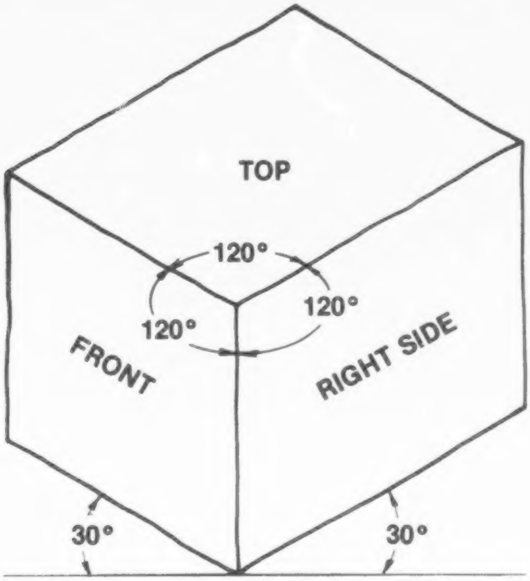


Thumbnail Sketches

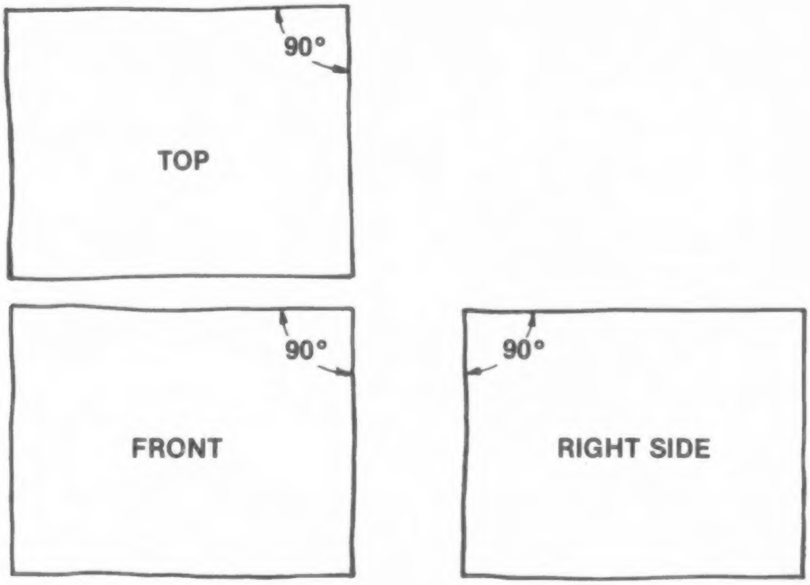

INTRODUCTION TO
NATURAL
ACID RAIN
GLOBAL WARMING
AIR POLLUTION
WATER POLLUTION
MAVCC
RESOURCES
MIDAMERICA VOCATIONAL CURRICULUM CONSORTIUM

Rough Sketch

# Engineering/Drafting Sketches

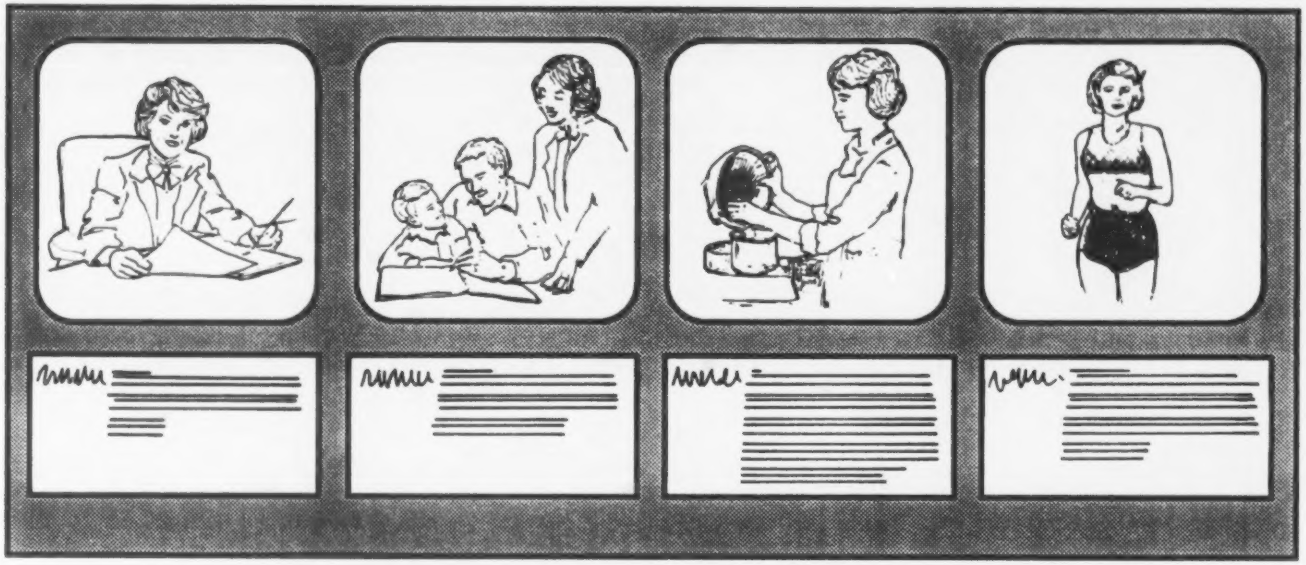

TOP
120°
120°
120°
FRONT
RIGHT SIDE
30°
30°

Pictorial Sketch


90°
TOP
90°
FRONT
90°
RIGHT SIDE

Multiview Sketch

# Storyboard



**A storyboard shows both the written descriptions and illustrations of the action.**

# Production Scripts

| | |
|---|---|
| SOUND: | B.G. Music. Fade out. |
| JENNIFER: | Oh, Tracy, I love your sweater. Where did you get it? |
| TRACY: | Thanks, Jennifer. I got it at the new store across from school. It's called the "Teen Shoppe," and it just has everything! And the prices are great too. |
| JENNIFER: | Let's go there tomorrow and shop. I'd love to see what they have. |
| SOUND: | B.G. music. Fade in. |
| ANNOUNCER: | Visit the "Teen Shoppe" for the latest fashions at Four-thirty-three South Main in Brookville. |

## Audio Script

| FRAME | TIME (sec) | VISUAL | NARRATION/S.E. |
|---|---|---|---|
| 1. | 5 | Two female teenagers sitting on bed talking to each other. M.S. of both girls, then C.U. of Jennifer. | **Jennifer:** Oh, Tracy, I love your sweater. Where did you get it? |
| 2. | 12 | C.U. of Tracy | **Tracy:** Thanks, Jennifer. I got it at the new store across from school. It's called the "Teen Shoppe," and it just has everything! And the prices are great too. |
| 3. | 5 | C.U. of Jennifer | **Jennifer:** Let's go there tomorrow and shop. I'd love to see what they have. |
| 4. | 8 | C.U. of Teen Shoppe shopping bag with logo. | **V.O. Announcer:** Visit the "Teen Shoppe" for the latest fashions at four-thirty-three South Main in Brookville. |

## Audiovisual Script

# DESIGNING MESSAGES
## UNIT B-2

## INFORMATION SHEET

I. **Terms and definitions**

A. Comprehensive layout — A full size, completed design of the finished product

B. Computer-aided drafting (CAD) and computer-aided drafting and design (CADD) — Processes that use a computer to create or modify a design

C. Design — A plan or sketch to be used as a guide in making something; the creative process for finding solutions to problems

D. Drafting — The representation of a "real" object on a two dimensional surface using applied rules

E. Format — Specifies the media, style, and arrangement to be used for transmission of a message

F. Freehand sketch — A drawing made without the use of special tools

(NOTE: Almost all design ideas have their beginning in freehand sketches.)

G. Graphics — Illustrations used to present information

H. Instrument drawings — Precise, accurate drawings made with the use of drafting equipment

I. Media — Means used for transmitting a message

Examples: Radio, television, photographs, newspapers

J. Readability — The level at which written material can be easily read by identified groups of people

(NOTE: The readability should match the audience.)

K. Text — Words used to present information

II. **Steps in designing a message**

A. Determine the audience — Decide what group of people that the message is to be communicated to and identify their characteristics and points of interest.

Examples: Children, parents, business executives, sports enthusiasts, retirees, travelers, teachers, brides, women, men, teens, etc.

## INFORMATION SHEET

B. Decide on the message content — List and organize the information that the message is to contain.

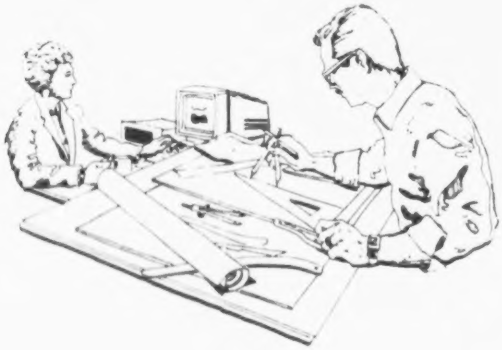
Examples: What should message say? How should it be said?

C. Decide on the format — Decide on how the message should appear to the targeted audience.

Examples: Book, illustration, photograph, TV show, movie, radio announcement, newspaper advertisement

D. Prepare preliminary message — Make sketches or scripts for message.

Example:



### III. Ways to design preliminary messages

A. Designing visual messages — Uses sketches to show preliminary message

B. Designing audio messages — Uses script to plan preliminary message

C. Designing audiovisual messages — Uses storyboards and scripts to plan preliminary message

## INFORMATION SHEET

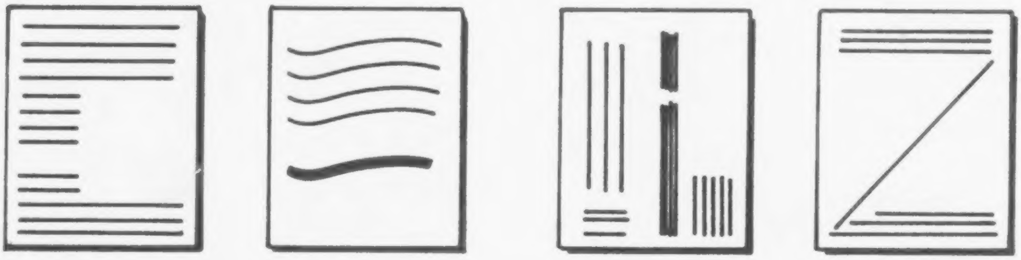
### IV. Elements of visual design

A. Space — The area allowed to work with

Examples: Piece of paper, billboard, package label

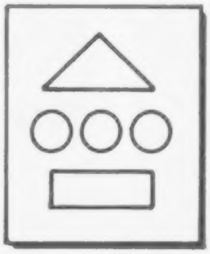
B. Line — Moves the reader's eye from one point to another; may be straight, curved, angled, heavy, or light

Examples:



C. Form — Gives an element shape; may be a square, rectangle, circle, triangle, or irregular shape

Example:



D. Color — Attracts the eye and provides contrast as well as sets the mood of a design

(NOTE: Red, yellow, and orange are warm colors. These colors seem to jump out from the page. Blue, green, and purple are cool colors. These colors seem to recede into the page. Dark colors make objects appear smaller. Light colors make objects appear larger.)

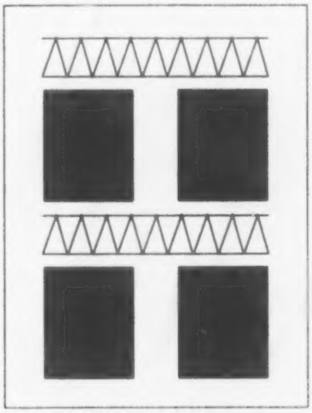
## INFORMATION SHEET

V. **Principles of visual design**

A. Balance — Distribution of weight on each side of a center point; may be formal or informal.

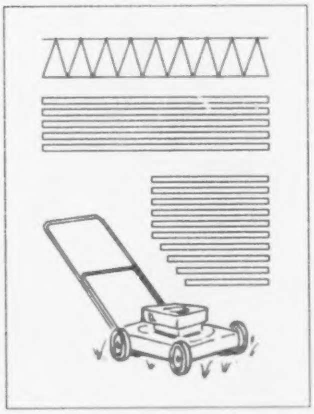
1. Formal balance — Symmetrical; achieved by identical or even placement on each side of the center point.

Example:



2. Informal balance — Asymmetrical; achieved by equalizing the weight of different elements in a design. A smaller element placed farther away from the central point can balance a larger element which is closer to the center.

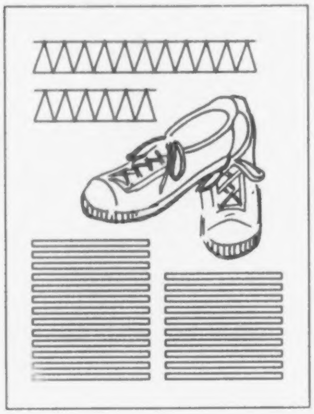
Example:

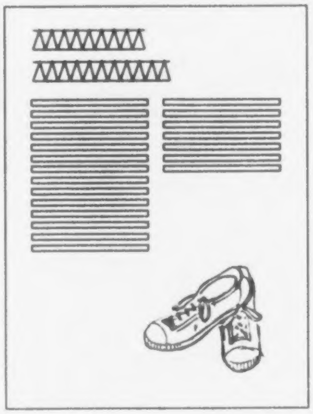


## INFORMATION SHEET

B. Proportion — Relationship between the sizes of the elements of the design.

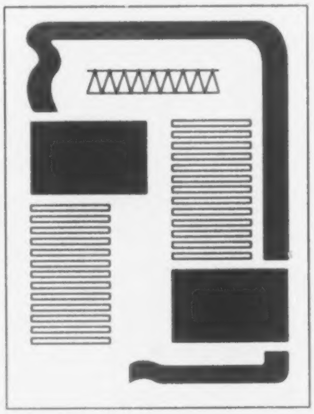
Example:





C. Rhythm — Directs and controls the motion of the reader's eye

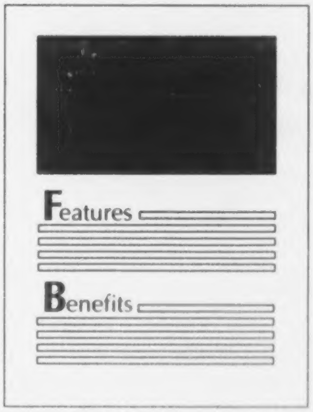
Example:



## INFORMATION SHEET

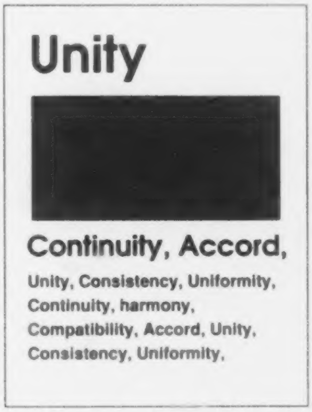
D. Contrast or emphasis — Used to create interest and attract attention by using differences in size, color, or appearance.

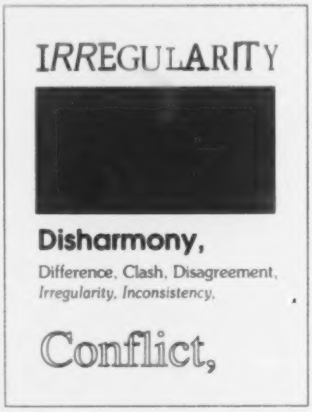
Example:


Features
Benefits

E. Unity — A combination of different elements to promote an undivided total effect. Similar forms or typefaces are commonly used in a design to promote unity.

Example:


Unity
Continuity, Accord,
Unity, Consistency, Uniformity,
Continuity, harmony,
Compatibility, Accord, Unity,
Consistency, Uniformity,


IRREGULARITY
Disharmony,
Difference, Clash, Disagreement,
Irregularity, Inconsistency,
Conflict,

## INFORMATION SHEET

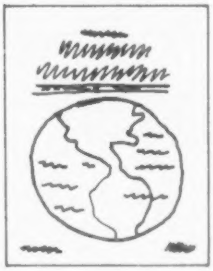
### VI. Types of sketches

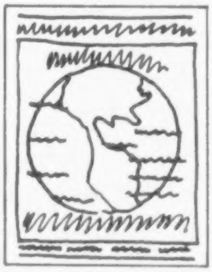
A. Commercial/graphic art sketches

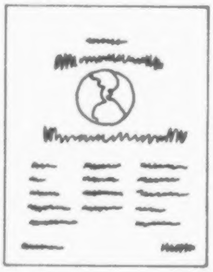
1. Thumbnail sketch — A small freehand sketch made quickly to show design ideas. Usually the sketch is smaller than final layout, but is in approximately the same proportion.

(NOTE: Usually more than one thumbnail is made to show different ideas.)

Examples:



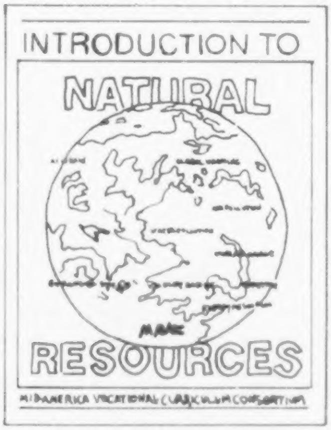




2. Rough sketch — A full size detailed sketch of a thumbnail

(NOTE: The rough is usually a clearer representation of the design. The rough sketch will later be used to make a comprehensive layout.)

Example:


INTRODUCTION TO
NATURAL
RESOURCES
MID-AMERICA VOCATIONAL CURRICULUM CONSORTIUM

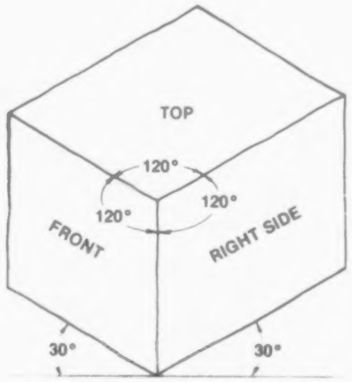
## INFORMATION SHEET

B. Engineering/drafting sketches

(NOTE: Engineers use sketches to present their ideas to drafters who can then prepare finished technical drawings.)

1. Pictorial — A picturelike, three-dimensional drawing of an object as it appears to the eye

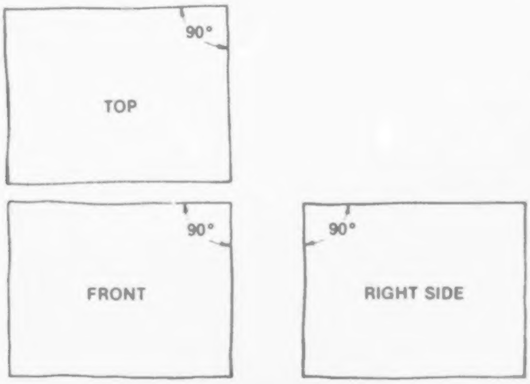
   Example:


TOP
120°
120°
120°
FRONT
RIGHT SIDE
30°
30°

Pictorial Sketch

2. Multiview — A drawing showing the separate views of an object, arranged so each view is related to the other views

   Example:


90°
TOP
90°
FRONT
90°
RIGHT SIDE

Multiview Sketch

## INFORMATION SHEET

**VII. Purposes of sketching**

A. To record ideas quickly and inexpensively

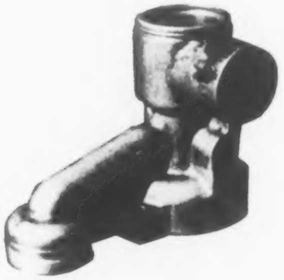
B. To show others a design idea in visual form

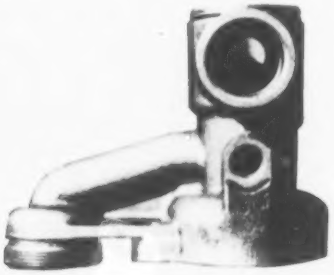
C. To "think through" the solution to a problem

**VIII. Steps in sketching**

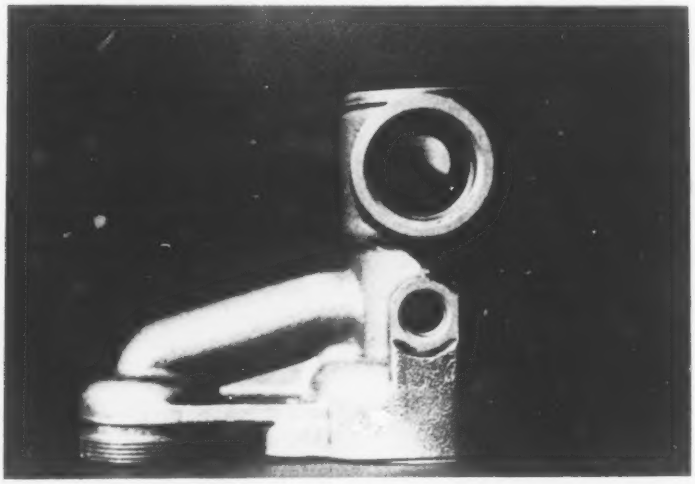
A. Decide which view of object is to be drawn.

(NOTE: Choose view which will show best overall shape of part.)



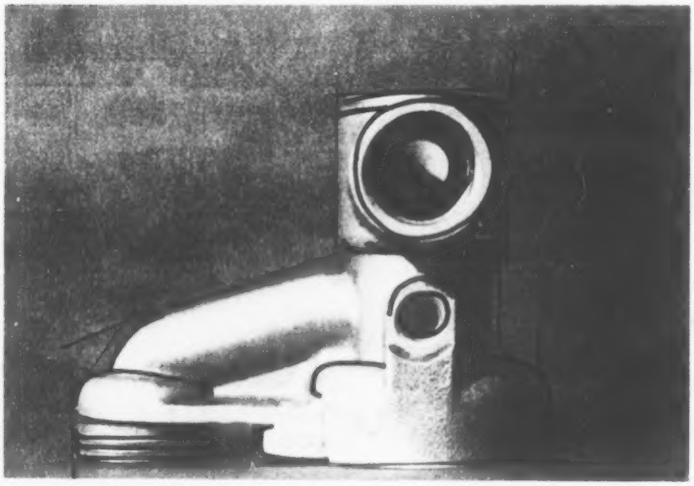


B. Block in lightly the overall shape of the object.

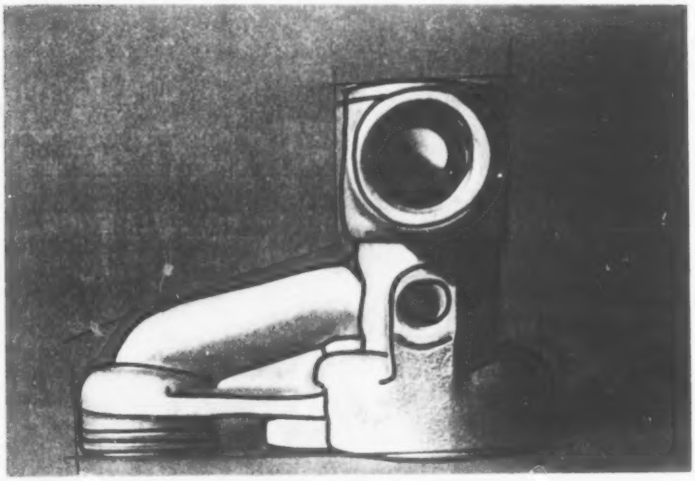


## INFORMATION SHEET

C. Add details such as interior lines, arcs, and circles.



D. Erase construction lines and darken object.



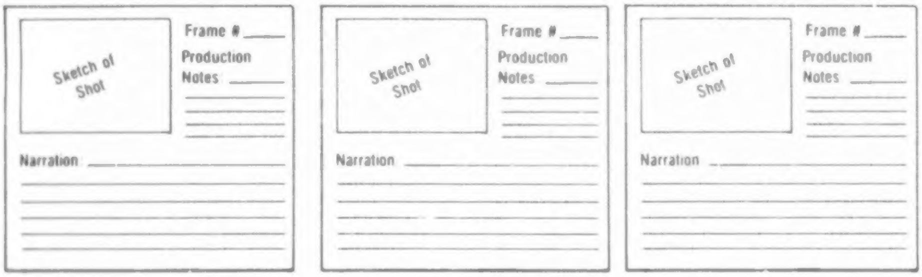
## INFORMATION SHEET

### IX. Methods for audio and audiovisual designing

A. Storyboard — Outlines the program's action with both pictures and written descriptions.

(NOTE: A storyboard allows the writer to rearrange the sequence of events if necessary. The storyboard is the basis for developing scripts.)

Example:


Sketch of Shot
Frame #
Production Notes
Narration
Sketch of Shot
Frame #
Production Notes
Narration
Sketch of Shot
Frame #
Production Notes
Narration

B. Audio script — A script of everything that is to be heard such as dialogue, music, and sound effects.

Example:

| | |
|---|---|
| SOUND: | B.G. Music. Fade out. |
| JENNIFER: | Oh, Tracy, I love your sweater. Where did you get it? |
| TRACY: | Thanks, Jennifer. I got it at the new store across from school. It's called the "Teen Shoppe," and it just has everything! And the prices are great too. |
| JENNIFER: | Let's go there tomorrow and shop. I'd love to see what they have. |
| SOUND: | B.G. music. Fade in. |
| ANNOUNCER: | Visit the "Teen Shoppe" for the latest fashions at Four-thirty-three South Main in Brookville. |

## INFORMATION SHEET

C. Audiovisual production script — A script for television, movies, or theater productions including all directions of performers' dialogue and techniques, technical crew instructions, scenery and props needed, and lighting, camera, and sound instructions.

Example:

| FRAME | TIME (sec) | VISUAL | NARRATION/S.E. |
|---|---|---|---|
| 1. | 5 | Two female teenagers sitting on bed talking to each other. M.S. of both girls, then C.U. of Jennifer. | **Jennifer:** Oh, Tracy, I love your sweater. Where did you get it? |
| 2. | 12 | C.U. of Tracy | **Tracy:** Thanks, Jennifer. I got it at the new store across from school. It's called the "Teen Shoppe," and it just has everything! And the prices are great too. |
| 3. | 5 | C.U. of Jennifer | **Jennifer:** Let's go there tomorrow and shop. I'd love to see what they have. |
| 4. | 8 | C.U. of Teen Shoppe shopping bag with logo. | **V.O. Announcer:** Visit the "Teen Shoppe" for the latest fashions at four-thirty-three South Main in Brookville. |

## DESIGNING MESSAGES
## UNIT B-2

## ASSIGNMENT SHEET #1—IDENTIFY ELEMENTS AND PRINCIPLES OF DESIGN

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Elements are identified | ______ |
| Principles are identified | ______ |
| Assignment is neat and completed on time | ______ |

Directions: Collect advertisements from newspapers or magazines that illustrate the following:

| **Elements** | **Principles** |
|---|---|
| Space | Balance |
| Line | Proportion |
| Form | Rhythm |
| Color | Contrast or emphasis |
| | Unity |

Describe parts of the ads which show the various elements and principles of design. Attach your descriptions to the ad and turn in to your instructor.

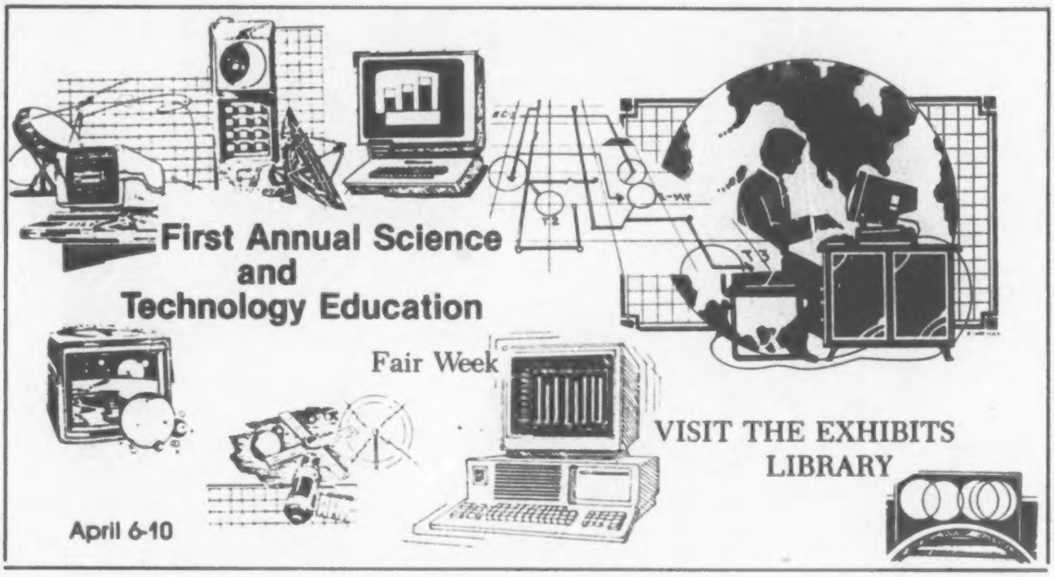
## DESIGNING MESSAGES
## UNIT B-2

## ASSIGNMENT SHEET #2—IMPROVE AN ADVERTISEMENT

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Suggestions will improve ad | ______ |
| Assignment is neat and completed on time | ______ |

Directions: Shown below is an advertisement that will be used in the school newspaper. List ways to improve it or redesign the ad on the back of this page. Remember the elements and principles of design as you add those improvements.


First Annual Science and Technology Education
Fair Week
VISIT THE EXHIBITS
LIBRARY
April 6-10

Ways to improve ad

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

# DESIGNING MESSAGES
## UNIT B-2

## ASSIGNMENT SHEET #3—DESIGN A MESSAGE

Name ______________________________ Overall Rating ______________

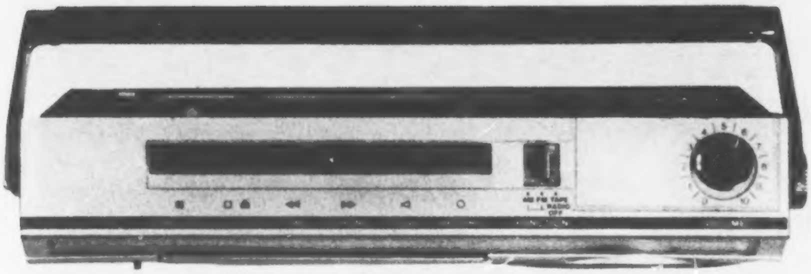
| EVALUATION CRITERIA | RATING |
|---|---|
| Audience, content, and format are determined correctly | ______ |
| Rough sketches or storyboard and script are developed correctly | ______ |
| Message is appropriate | ______ |
| Assignment is neat and completed on time | ______ |

(NOTE: This assignment should be in accordance with the project selected in Unit B-1, Assignment Sheet #4.)

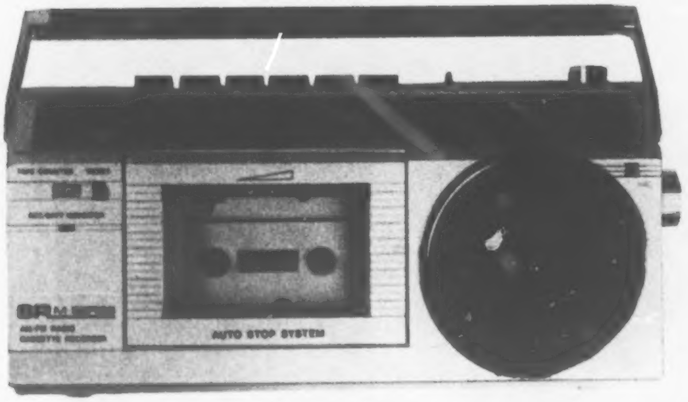
Directions: Plan a message that will help you to sell your product or service such as a visual or audiovisual advertisement, a package, or a logo. Determine your audience, content, and format. Prepare the rough sketch or storyboard and script needed to show your idea.

## ASSIGNMENT SHEET #4

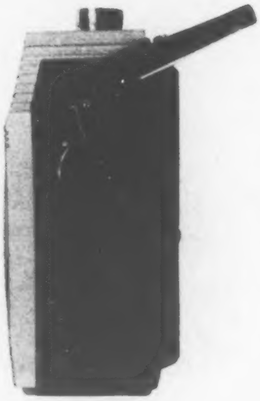
C.



TOP VIEW


AUTO STOP SYSTEM

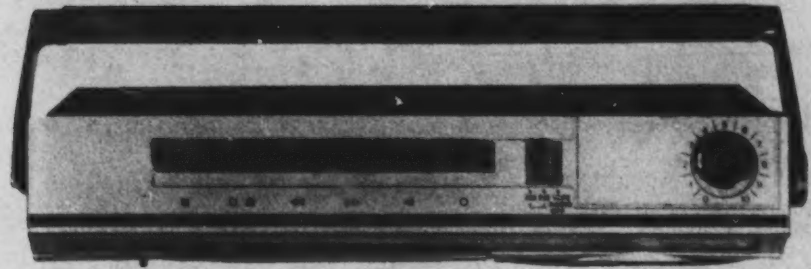
FRONT VIEW



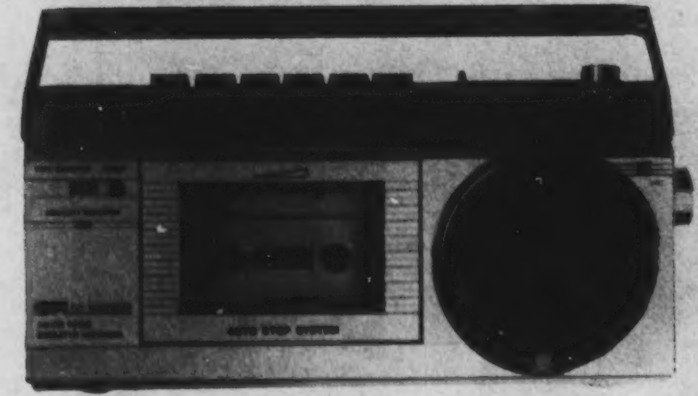
RIGHT SIDE VIEW

## ASSIGNMENT SHEET #4

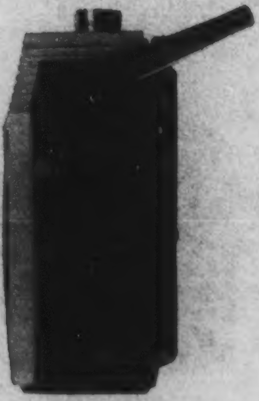
C.



TOP VIEW



FRONT VIEW



RIGHT SIDE VIEW

## DESIGNING MESSAGES
## UNIT B-2

### TEST

Name ______________________________ Score ____________________

1. Match the terms on the right with the correct definitions.

_____a. Illustrations used to present information

_____b. Means used for transmitting a message

_____c. A drawing made without the use of special tools

_____d. Words used to present information

_____e. A plan or sketch to be used as a guide in making something; the creative process for finding solutions to problems

_____f. The representation of a "real" object on a two dimensional surface using applied rules

_____g. Processes that use a computer to create or modify a design

_____h. Specifies the media, style, and arrangement to be used for transmission of a message

_____i. Precise, accurate drawings made with the use of drafting equipment

_____j. The level at which written material can be easily read by identified groups of people

1. Comprehensive layout
2. Computer-aided drafting and design
3. Design
4. Drafting
5. Format
6. Freehand sketch
7. Graphics
8. Instrument drawings
9. Media
10. Readability
11. Text

2. Arrange in order the following steps used in designing a message by placing the correct sequence numbers (1-4) in the appropriate blanks.

_____a. Decide on the format.

_____b. Prepare preliminary message.

_____c. Determine the audience.

_____d. Decide on the message content.

## TEST

3. Complete the following statements concerning ways to design preliminary messages by circling the correct words.

   a. Designing audiovisual messages uses storyboards and (**sketches, scripts**).

   b. Designing visual messages uses (**sketches, scripts**).

4. Match the elements of visual design on the right with their correct definitions.

   _____a. Moves the reader's eye from one point to another; may be straight, curved, angled, heavy, or light

   _____b. Attracts the eye and provides contrast as well as sets the mood of the design

   _____c. Gives an element shape; may be a square, rectangle, circle, triangle, or irregular shape

   _____d. The area allowed to work with

   1. Color
   2. Space
   3. Contrast
   4. Form
   5. Line

5. Complete the following statements concerning the principles of visual design by circling the correct words.

   a. The relationship between the sizes of the elements of the design is (**color, balance, proportion**).

   b. (**Contrast, Rhythm**) directs and controls the motion of the reader's eye.

   c. A combination of different elements to promote an undivided total effect is (**unity, color**).

   d. (**Contrast, Balance**) is used to create interest and attract attention by using differences in size, color, or appearance.

   e. Distribution of weight on each side of a center point is (**emphasis, balance**).

6. Match types of sketches on the right with the correct descriptions.

   _____a. A small freehand sketch made quickly to show design ideas. Usually the sketch is smaller than final layout, but is in approximately the same proportion.

   _____b. A drawing showing the separate views of an object, arranged so each view is related to the other views.

   _____c. A picturelike, three-dimensional drawing of an object as it appears to the eye

   _____d. A full size detailed sketch of a thumbnail

   1. Layout
   2. Multiview
   3. Pictorial
   4. Rough
   5. Thumbnail

## TEST

7. List one purpose of sketching. ______________________________________________

______________________________________________________________

8. Arrange in order the steps in sketching by placing the correct sequence numbers (1-4) in the appropriate blanks.

    _____a. Block in lightly the overall shape of the object.

    _____b. Erase construction lines and darken object.

    _____c. Add details such as interior lines, arcs, and circles.

    _____d. Decide which view of object is to be drawn.

9. Match the methods for audio and audiovisual designing with the correct descriptions.

    _____a. Outlines the program's action with both pictures and written descriptions.

    _____b. A script of everything that is to be heard such as dialogue, music, and sound effects.

    _____c. A script for television, movies, or theater productions including all directions of performers' dialogue and techniques, technical crew instructions, scenery and props needed, and lighting, camera, and sound instructions.

    1. Audio script
    2. Audiovisual production script
    3. Storyboard

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

10. Identify elements and principles of design. (Assignment Sheet #1)

11. Improve an advertisement. (Assignment Sheet #2)

12. Design a message. (Assignment Sheet #3)

13. Sketch objects. (Assignment Sheet #4)

## DESIGNING MESSAGES
## UNIT B-2

### ANSWERS TO TEST

1. a. 7
   b. 9
   c. 6
   d. 11
   e. 3
   f. 4
   g. 2
   h. 5
   i. 8
   j. 10

2. a. 3
   b. 4
   c. 1
   d. 2

3. a. Scripts
   b. Sketches

4. a. 5
   b. 1
   c. 4
   d. 2

5. a. Proportion
   b. Rhythm
   c. Unity
   d. Contrast
   e. Balance

6. a. 5
   b. 2
   c. 3
   d. 4

7. Any one of the following:

   a. To record ideas quickly and inexpensively
   b. To show others a design idea in visual form
   c. To "think through" the solution to a problem

8. a. 2
   b. 4
   c. 3
   d. 1

## ANSWERS TO TEST

9. a. 3
   b. 1
   c. 2

10.-13. Evaluated to the satisfaction of the instructor

# PRODUCING AND TRANSMITTING MESSAGES
## UNIT B-3

### UNIT OBJECTIVE

After completion of this unit, the student should be able to apply techniques to produce and transmit messages. Competencies will be demonstrated by completing the assignment sheets, lab activity sheet, and unit test with a minimum score of 85 percent.

### SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to producing and transmitting messages with the correct definitions.
2. Complete statements concerning the methods of producing and transmitting visual messages.
3. Match methods of producing and transmitting audio and audiovisual messages with the correct descriptions.
4. Match emerging communication transmission technologies with the correct descriptions.
5. Identify basic drafting tools and equipment.
6. Distinguish between the systems of measurement.
7. Select true statements concerning multiview drawing.
8. Read units of measurement. (Assignment Sheet #1)
9. Make a three-view sketch. (Assignment Sheet #2)
10. Complete multiview drawings. (Assignment Sheet #3)
11. Produce and transmit a visual message. (Assignment Sheet #4)
12. Produce and transmit an audio or audiovisual message. (Assignment Sheet #5)
13. Construct and demonstrate a fiberoptic simulator. (Lab Activity Sheet #1)

## PRODUCING AND TRANSMITTING MESSAGES
## UNIT B-3

### SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher edition only and are designed to be used with the following objectives:

TM 1 and 2 — Manual Drafting Tools — Objective 5A
TM 3 — CAD Equipment — Objective 5B
TM 4 — Multiview Drawing — Objective 7

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information, assignment and lab activity sheets.

F. Discuss information, assignment, and lab activity sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. Use Teacher Supplement #1 to present AIT video B-3. This video was developed by the Agency for Instructional Technology (AIT) and a consortium of states to accompany this publication. Contact your state supervisor of technology education for copies, or contact AIT directly for more information:

   Agency for Instructional Technology (AIT)
   Box A, Bloomington, IN 47402
   800-457-4509 or 812-339-2203

2. Use Teacher Supplements #2 and #3 to help students understand this unit's terminology. Make copies (fronts only) for your students. The answers are on the backs of the supplements.

3. Plan to use this unit to refine message designs initiated in Unit B-2

4. Develop individual modules for teaching this unit.

5. Discuss the progression of drafting from manual instruments to CAD and the increase of speed along the way.

6. Demonstrate the use of a precision drawing system template. Refer to suggested supplemental resources for address.

## SUGGESTED ACTIVITIES

   7. Demonstrate the orthographic projection concept using a clear cube container or other cube-type container.

   8. Demonstrate the use of your CAD system, its hardware, software, and the types of drawings it can produce. Show samples of drawings made by both your CAD system and other more sophisticated systems.

   9. Demonstrate the procedure for digitizing visual images. Software packages are available from your local computer stores.

   10. Demonstrate the equipment needed for students to complete Assignment Sheets #3-#5.

   11. Stress laboratory safety in all areas of activity, especially Lab Activity #1.

   12. Display an example of the fiberoptic simulator prior to Lab Activity #1.

   13. Assist students in communicating with the fiberoptic simulator. (Lab Activity #1)

   14. Refer to the next unit (Unit B-4) for criteria on evaluating messages.

H. Administer test.

I. Evaluate test.

J. Reteach if necessary.

## REFERENCES USED IN DEVELOPING THIS UNIT

A. Scott, Raymond C., Ronald L. Foy, and Mark Schwendan. *Drafting Fundamentals.* Peoria, IL: Bennett McKnight Publishing Co., 1985.

B. Jones, Ronald E. and Janet L. Robb. *Discovering Technology Communication.* Dallas, TX: Harcourt Brace Jovanovich Publishers, 1986.

C. Bame, E. Allen and Paul Cummings. *Exploring Technology.* Worcester, MA: Davis Publishing, Inc., 1980.

D. Schertz, Karen. *Basic Drafting.* Stillwater, OK: Mid-America Vocational Curriculum Consortium, 1990.

## SUGGESTED ACTIVITIES

## SUGGESTED SUPPLEMENTAL RESOURCES

A. *Precision Drawing System* — Useful drafting tool that replaces several conventional tools. Several scales are available from:

InterMark Enterprises
610 West Broadway, Suite 213
Tempe, Arizona 85282

B. *Stepping into CAD* — A technical drafting program using the AutoCAD microcomputer program. Available from:

Autodesk, Inc.
2320 Marinship Way
Sausalito, CA 94965

C. Supplies for a simplified method of screen printing that uses a thermal copier to produce screens. Available from:

Welsh Products, Inc.
1201 East 5th Street, P.O. Box 845
Benicia, CA 94510
707-745-3252 or 554-3222

D. *Lines and Views* — A guide for teaching grid drafting and the coordinate system. Available from:

Nelson Parke
805 South Devonshire
Springfield, MO 65802

E. *DesignCAD and DesignCAD 3D*, similar to AutoCAD, but lower priced. Available to schools from:

American Small Business Computers
327 South Mill Street
Pryor, OK 74361

BEST COPY AVAILABLE

## SUGGESTED ACTIVITIES

F. Basic printing/desktop publishing programs available for computers include:

1. *Printmaster* (thousands of clip art graphics available from IBM users domain list below)
2. *Print Shop* (thousands of clip art graphics available)
3. *Newsmaster*
4. *ByLine*

IBM Public Domain Software Distributor:

Public Brand Software
P.O. Box 51315
Indianapolis, IN 46251
800-426-3475

G. Many programs are available for Apple II, Commodore, and IBM computers to create titles and visual narration/graphics for television commercial development. IBM version requires computers with a composite output port (RCA jack) to connect to a VCR.

1. *Home Video Producer*, for Apple, Commodore, and IBM
Epyx
P.O. Box 8020
Redwood City, CA 94063
415-366-0606

2. *VCR Companion* (Apple II only)
Broderbund Software
17 Paul Drive
San Rafael, CA 84903-2101
415-492-3500

3. *Video Title Shop* (Commodore only)
IntelliCreations
19808 Nordhoff Place
Chatsworth, CA 91311
818-886-5922

H. Videotapes

1. *AutoCAD—A Professional Tool.* 1/2" VHS. Color. 27 min. 1985. Available from:

Autodesk, Inc.
2320 Marinship Way
Sausalito, CA 94965

## SUGGESTED ACTIVITIES

2. *Layouts and Mechanicals.* 1/2" VHS. Color. 15 min. 1982. Available from:

   Oberlin Color Press
   100 W. Airport Road
   Stillwater, OK 74074
   405-743-2840

3. *Producing and Transmitting Messages.* 1/2" VHS. Color. 15 min. 1990. Available from:

   Agency for Instructional Technology
   Box A
   Bloomington, IN 47402
   800-457-4509

4. *Opportunities in Graphic Communications.* Film or video. Color. 15 min. Sponsored by the National Printing Equipment and Supply Association, Inc. Available from:

   Modern Talking Picture Service
   5000 Park Street North
   St. Petersburg, FL 33709
   813-541-5763

# PRODUCING AND TRANSMITTING MESSAGES
## UNIT B-3

## TEACHER SUPPLEMENT #1—USING AIT VIDEO B-3

### Introduction and Program Summary (16:27)

This program is about producing messages for print and television, and what technology is used to create and transmit them.

A visit to *USA Today* demonstrates the central role of computers, which permit reporters to call up information from wire services and data banks, write their stories, send them to an editor, and then transmit final copy to a typesetting machine. Computers do half the layout; with the help of a laser scan, pictures are color-separated and reassembled for printing. A facsimile scanner (fax machine) "reads" the page and changes it to digital signals for transmission via satellite to 32 printing plants. In these the process is reversed to print identical newspapers simultaneously across the country.

The narrator reviews the communication model, using the Live Aid concert as an example. Simultaneous transmission by 14 satellites produced feedback in the form of money pouring in from all over the world. Then the video shows how a title sequence is created with the help of computerized "paint" programs and storyboards. A glance at the future introduces the potential of fiberoptics.

### Video Program Objectives

The video program will illustrate that

- messages are produced for print and television through a variety of methods, using drawing, video, and other production processes
- messages are transmitted by telephone, television, computer modem, satellite, and other means
- emerging transmission technologies—lasers, fiberoptics, and satellites—enable a message to be transmitted simultaneously throughout the world

### Before the Program

1. Tell your students that this program shows a few methods used to produce messages for print, television, and video and for transmitting messages once they are produced. Even familiar methods, such as telephones and television, may involve such new technologies as satellites, fiberoptics, and lasers.
2. Tell students that the program will make use of the communication systems model from Program B-1: sender, message, receiver, feedback.
3. Relate the content of the program to current lab activities.
4. Tell students to listen for the following terms and careers. (You might write them on the chalkboard.)

## TEACHER SUPPLEMENT #1

### Terms

lasers
airbrush
digital image
word processor
typesetter
color separation
facsimile scanner
fiberoptics
transmission
modem
hologram

### Careers

reporter
editor
typesetter
video producer
commercial artist
video artist

### After the Program: Questions for Discussion and Review

1. What were the terms of the communication system model? (*sender, message, receiver, and feedback*)

2. What examples in the video program illustrate the communication model? (*newspaper story; Live Aid concert*)

3. Describe methods used to produce messages that were shown in the video. (*computers, typesetting, computerized photography, paste-up, color stripping, singing*) What other methods of producing messages can students suggest? (*gesturing, writing, typewriting, drafting, painting, speaking, hieroglyphics, printing, photocopying*)

4. What methods for transmitting messages were shown in the video? (*computer networks, telephones, lasers, facsimile scanner (fax machine), satellites and satellite dishes, television antennas, broadcast signals, fiberoptics*) What other methods of transmitting messages can students suggest? How were messages transmitted 50 years ago? Two hundred years ago? (*Their answers might include radio, telegraph, boats, phonographs, tape recorders, letters, and even carrier pigeons.*)

5. The *USA Today* newspaper was transmitted by satellite to 32 different printing plants. What other "messages" can be transmitted via satellite? (*computer data, telephone conversations, television signals*)

6. What communication technology was necessary for the production and transmission of the Live Aid concert? (*television cameras, microphones, antennas, satellites*) How did the other technological systems—manufacturing, construction, transportation—contribute to the communication of the Live Aid message? (*manufacture of speakers, vans, television sets; construction of the stage, highways, parking lots, stadium; transportation of people and equipment by plane, bus, car, van)*

7. Think of a variety of ways to transmit messages. What message does an architect transmit to a building contractor so that the contractor constructs a house according to the ideas of the architect? (*a blueprint or plan*) How do politicians seeking government office transmit their ideas? (*speeches, ads, and press events*) How do you transmit messages? (*Encourage students to think about a broad range of message-sending—telephone conversations, letters, asking questions in class, putting up posters, homework exercises, participating in music or drama productions, selling items to raise money for some group or program.*)

## TEACHER SUPPLEMENT #1

8. How will messages be produced and transmitted in the future? How might they change the way we live? (*Videophones may be developed so that we see the person we are talking to; it is already as easy and quick to transmit visual material—documents, pictures, graphs—by using fax machines as it is to transmit voices over long distances.*)

## PRODUCING AND TRANSMITTING MESSAGES
## UNIT B-3

### TEACHER SUPPLEMENT #2—CROSSWORD PUZZLE

Name ______________________________ Date ____________________

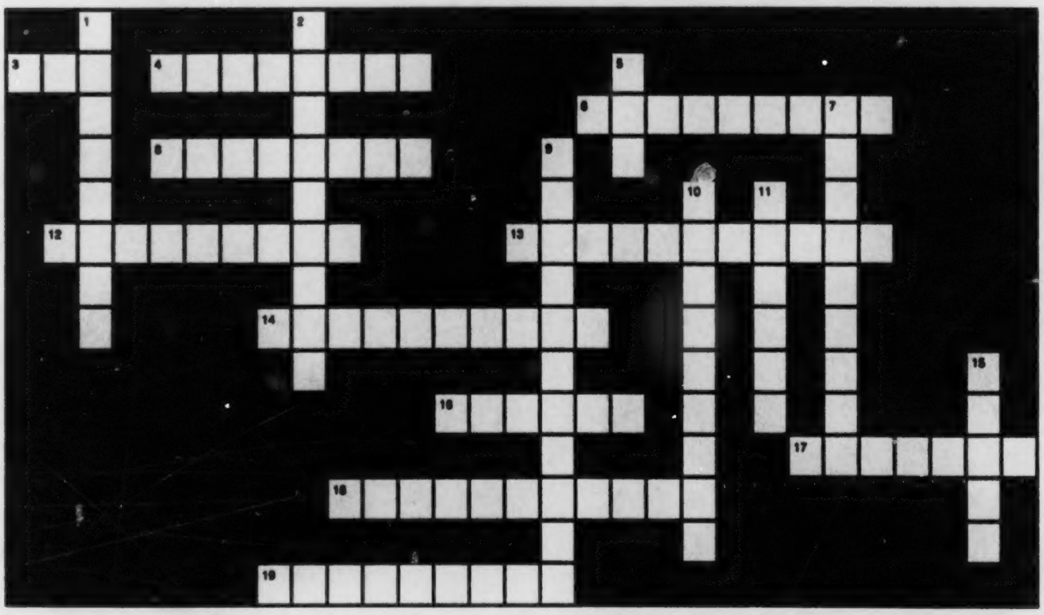
Directions: Use the clues below to solve the crossword puzzle.

ACROSS

3. An electronic device used to record and play videotapes
4. An electronic device that manages data
6. Man-made objects that orbit the earth
8. Transferring images from a carrier to a surface
12. Wireless transmission over a long distance
13. Set of numbers that locate a point, line, etc.
14. Basic system includes camera, recorder, etc.
16. A measuring system based on ten
17. Type of publishing that uses a computer system
18. Transmits through fine strands of glass or plastic
19. A measuring system divided into 1/16, 1/8, etc.

DOWN

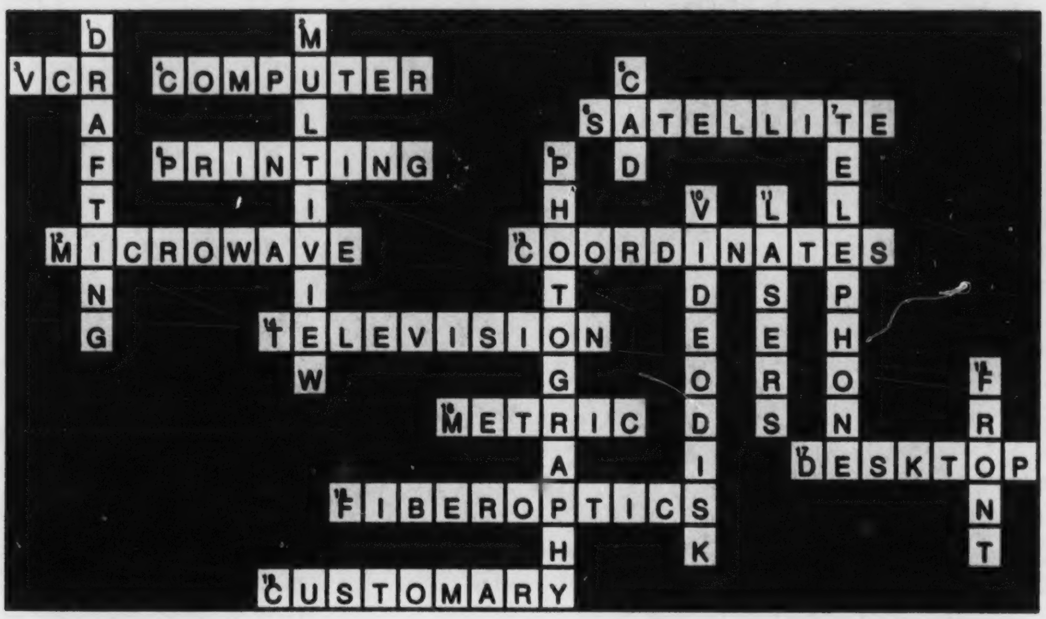
1. Language of industry
2. Type of drafting that shows three views of object
5. Use of computer to create designs or drawings
7. Audio system that transmits through wire or cable
9. The process of producing images on sensitive paper
10. A record-like disk that records video images
11. Transmits using coherent electromagnetic radiation
15. The three principal views are _____, top, and right



***Duplication Permitted***

## TEACHER SUPPLEMENT #2

## CROSSWORD PUZZLE ANSWER KEY


1 DRAFTING
2 MULTIVIEW
3 VCR
4 COMPUTER
5 CAD
6 SATELLITE
7 TELEPHONE
8 PRINTING
9 PHOTOGRAPH
10 VIDEODISK
11 LASERS
12 MICROWAVE
13 COORDINATES
14 TELEVISION
15 FRONT
16 METRIC
17 DESKTOP
18 FIBEROPTICS
19 CUSTOMARY

# PRODUCING AND TRANSMITTING MESSAGES
## UNIT B-3

## TEACHER SUPPLEMENT #3 — WORD SEARCH

Name ______________________________ Date ____________________

Directions: Find the words below hidden in the puzzle. Circle the words that you find.

COORDINATES
CUSTOMARY
DRAFTING
METRIC
VCR
PHOTOGRAPHY
TELEPHONE
COMPUTER
LASERS
FIBEROPTICS
MULTIVIEW
PRINTING
RADIO
TELEVISION
MICROWAVE
DESKTOP
FRONT
VIDEODISK
SATELLITE
SCANNER
CAD

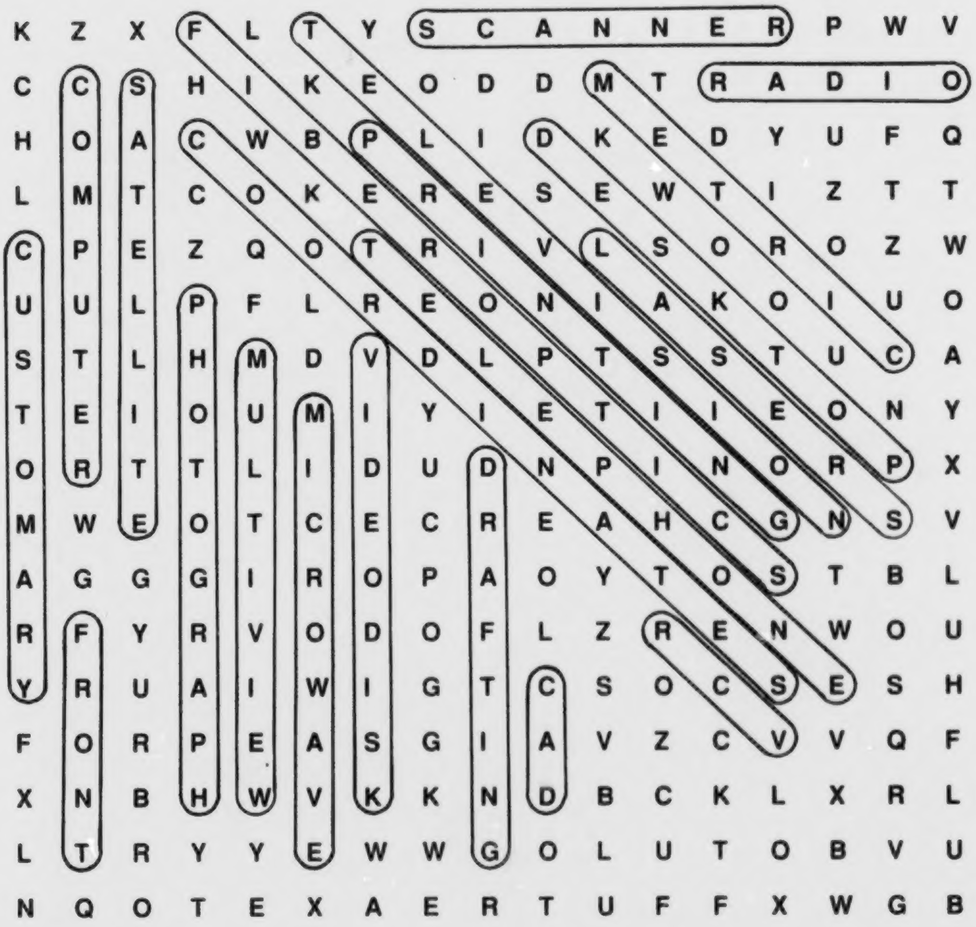
| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| K | Z | X | F | L | T | Y | S | C | A | N | N | E | R | P | W | V |
| C | C | S | H | I | K | E | O | D | D | M | T | R | A | D | I | O |
| H | O | A | C | W | B | P | L | I | D | K | E | D | Y | U | F | Q |
| L | M | T | C | O | K | E | R | E | S | E | W | T | I | Z | T | T |
| C | P | E | Z | Q | O | T | R | I | V | L | S | O | R | O | Z | W |
| U | U | L | P | F | L | R | E | O | N | I | A | K | O | I | U | O |
| S | T | L | H | M | D | V | D | L | P | T | S | S | T | U | C | A |
| T | E | I | O | U | M | I | Y | I | E | T | I | I | E | O | N | Y |
| O | R | T | T | L | I | D | U | D | N | P | I | N | O | R | P | X |
| M | W | E | O | T | C | E | C | R | E | A | H | C | G | N | S | V |
| A | G | G | G | I | R | O | P | A | O | Y | T | O | S | T | B | L |
| R | F | Y | R | V | O | D | O | F | L | Z | R | E | N | W | O | U |
| Y | R | U | A | I | W | I | G | T | C | S | O | C | S | E | S | H |
| F | O | R | P | E | A | S | G | I | A | V | Z | C | V | V | Q | F |
| X | N | B | H | W | V | K | K | N | D | B | C | K | L | X | R | L |
| L | T | R | Y | Y | E | W | W | G | O | L | U | T | O | B | V | U |
| N | Q | O | T | E | X | A | E | R | T | U | F | F | X | W | G | B |

*Duplication Permitted*

118-B

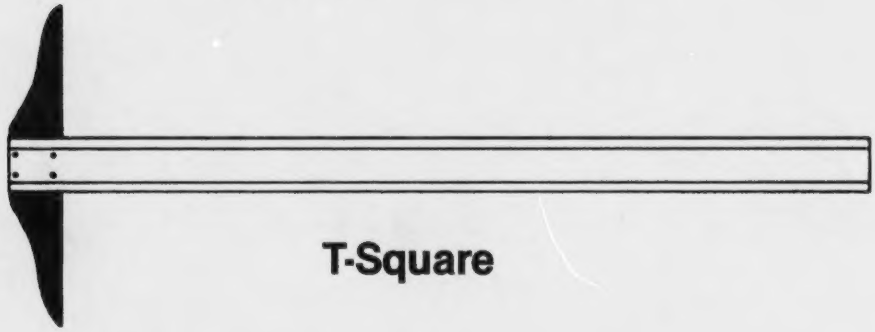
## TEACHER SUPPLEMENT #3

## WORD SEARCH ANSWER KEY

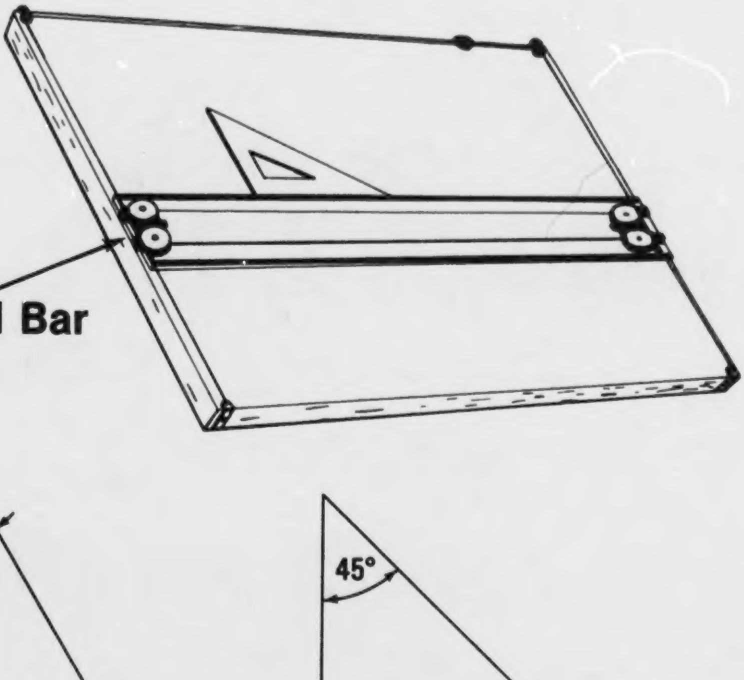


| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| K | Z | X | F | L | T | Y | S | C | A | N | N | E | R | P | W | V |
| C | C | S | H | I | K | E | O | D | D | M | T | R | A | D | I | O |
| H | O | A | C | W | B | P | L | I | D | K | E | D | Y | U | F | Q |
| L | M | T | C | O | K | E | R | E | S | E | W | T | I | Z | T | T |
| C | P | E | Z | Q | O | T | R | I | V | L | S | O | R | O | Z | W |
| U | U | L | P | F | L | R | E | O | N | I | A | K | O | I | U | O |
| S | T | L | H | M | D | V | D | L | P | T | S | S | T | U | C | A |
| T | E | I | O | U | M | I | Y | I | E | T | I | I | E | O | N | Y |
| O | R | T | T | L | I | D | U | D | N | P | I | N | O | R | P | X |
| M | W | E | O | T | C | E | C | R | E | A | H | C | G | N | S | V |
| A | G | G | G | I | R | O | P | A | O | Y | T | O | S | T | B | L |
| R | F | Y | R | V | O | D | O | F | L | Z | R | E | N | W | O | U |
| Y | R | U | A | I | W | I | G | T | C | S | O | C | S | E | S | H |
| F | O | R | P | E | A | S | G | I | A | V | Z | C | V | V | Q | F |
| X | N | B | H | W | V | K | K | N | D | B | C | K | L | X | R | L |
| L | T | R | Y | Y | E | W | W | G | O | L | U | T | O | B | V | U |
| N | Q | O | T | E | X | A | E | R | T | U | F | F | X | W | G | B |

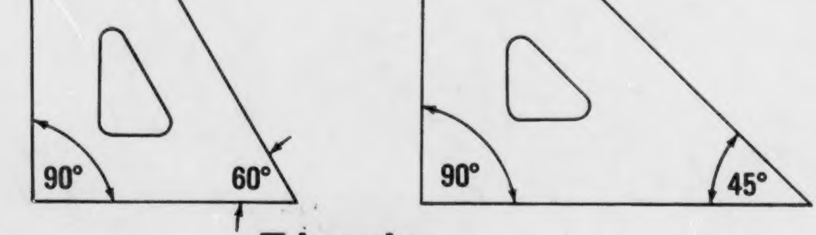
# Manual Drafting Tools and Equipment



T-Square



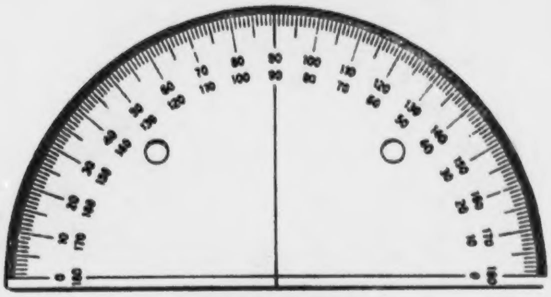
Parallel Bar


30°
90°
60°
45°
90°
45°

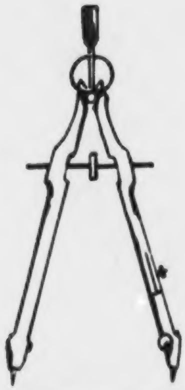
Triangles

# Manual Drafting Tools and Equipment

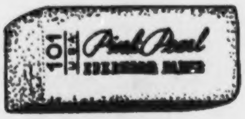
(Continued)



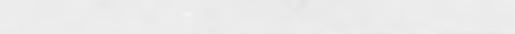
Protractor



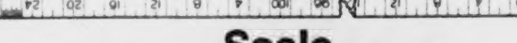
Compass


101
Pink Pearl

Eraser

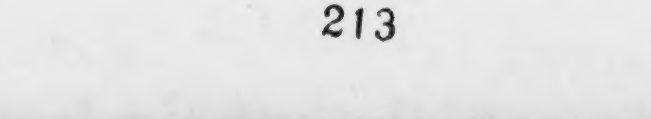


Wooden



Mechanical

Pencils

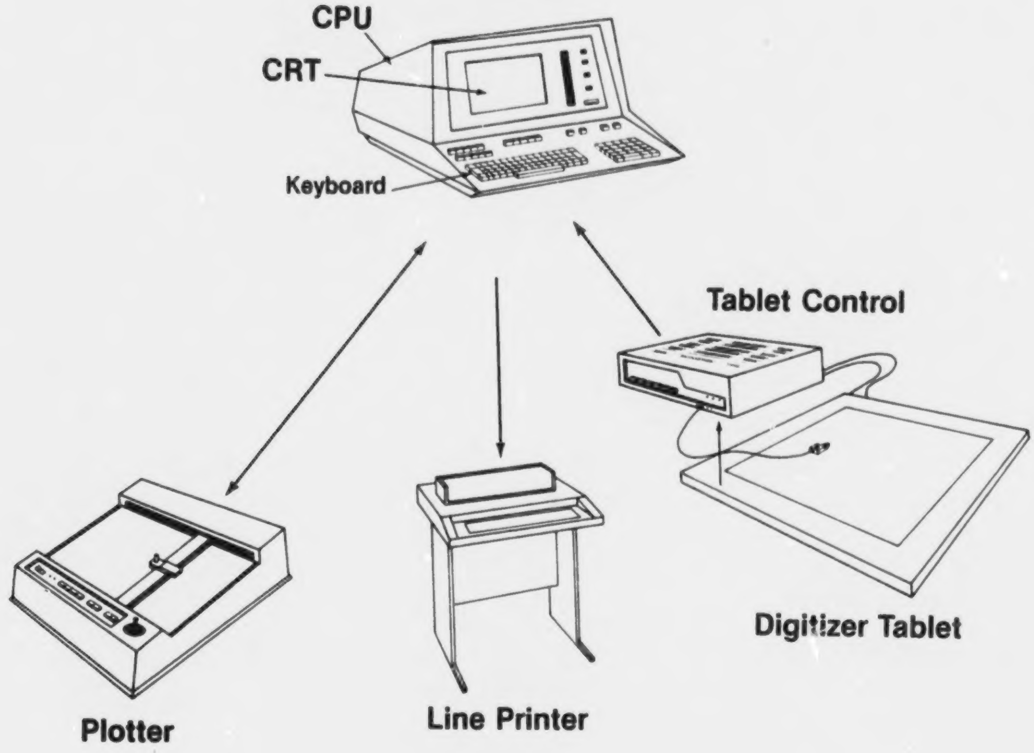


Scale

(Several types available)

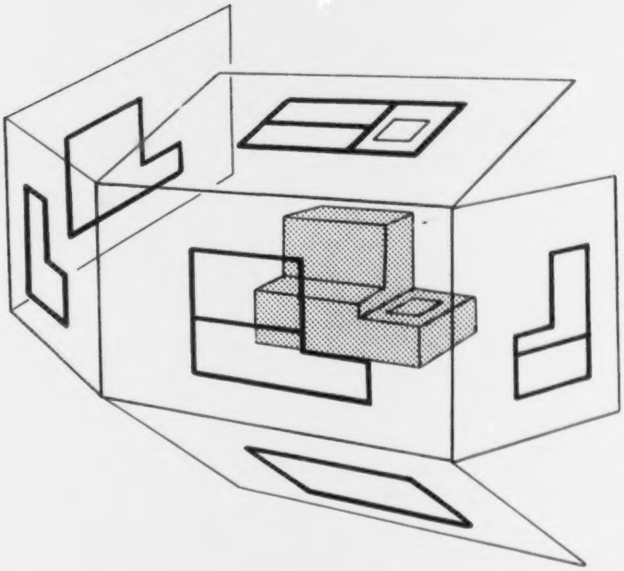
# CAD Equipment

## (Microcomputer)

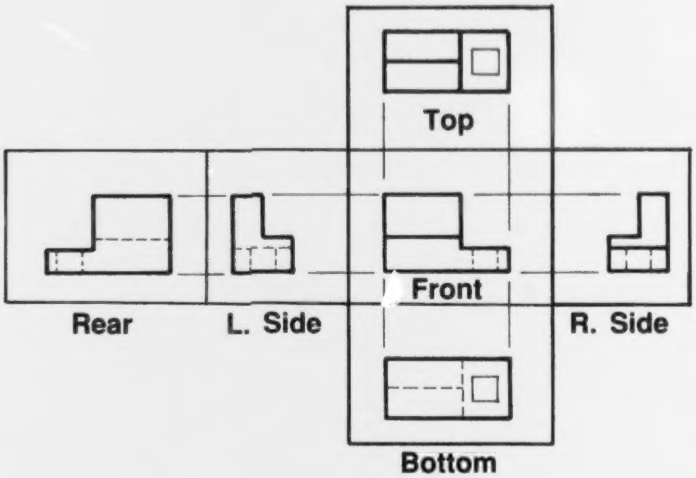

CPU
CRT
Keyboard
Tablet Control
Digitizer Tablet
Plotter
Line Printer

ETE-163-D

# Multiview Drawing



All planes revolve until they align with frontal plane.


Top
Rear
L. Side
Front
R. Side
Bottom

Six views are possible.

# PRODUCING AND TRANSMITTING MESSAGES
## UNIT B-3

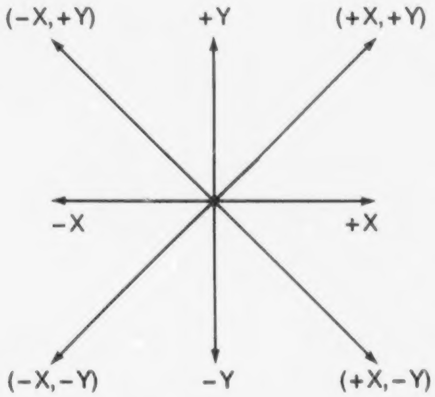
## INFORMATION SHEET

I. **Terms and definitions**

A. Computer-aided drafting (CAD) and computer-aided drafting and design (CADD) — Using a computer to create or modify designs and drawings

B. Coordinates — Set of numbers that locate a point on a line, on a surface (plane), or in space

(NOTE: Cartesian coordinates use two or three intersecting straight-line axes. Coordinates are especially helpful when working on a CAD system.)



C. Graphics — Illustrations used to present information

D. Multiview drawing — The process of describing an object by drawing several (often three) views of that object

E. Scale drawing — A drawing that is made larger or smaller than the original object

F. Scanner — An electronic device that converts printed text and graphics into electronic images that can be read by a computer

G. Text — Words used to present information

H. Videodisk — Recording of audio and video messages on a hard plastic disk similar to a phonograph record

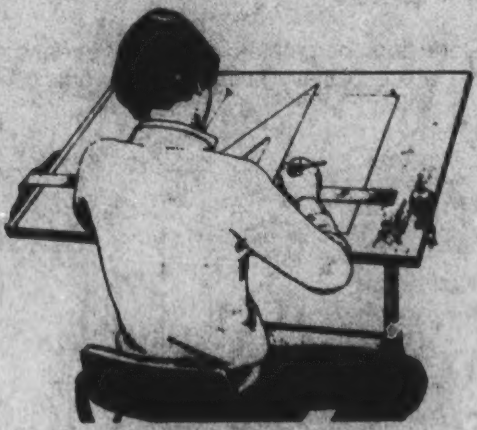
I. Videotape — Recording of audio and video messages on a magnetic cassette tape

## INFORMATION SHEET

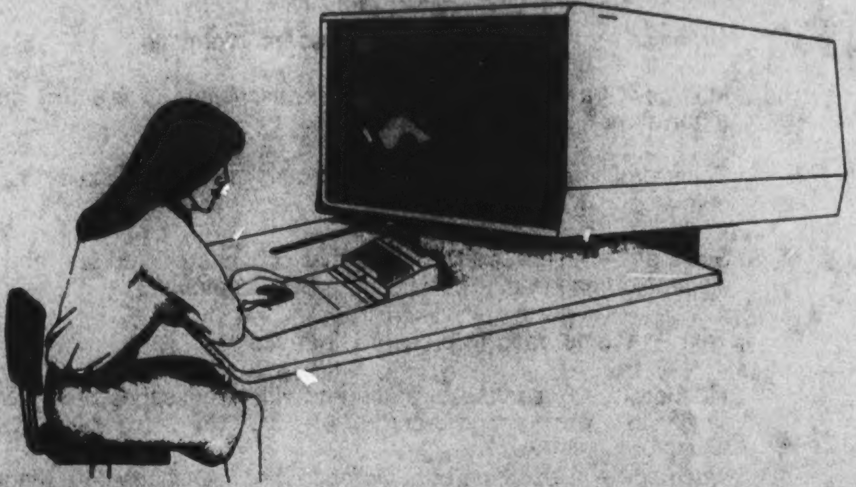
II. **Methods of producing and transmitting visual messages**

A. Drafting — The universal language of industry and modern technology. It is used to communicate ideas and specific information. Several methods may be used.

1. Manual drafting — Uses traditional tools such as triangle, T-squares, and protractors.

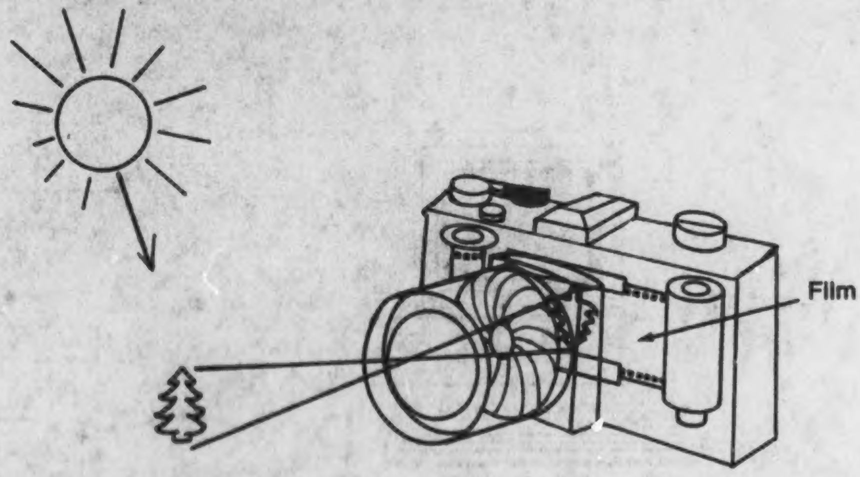


2. Computer-aided drafting (CAD) — Uses computer hardware and software

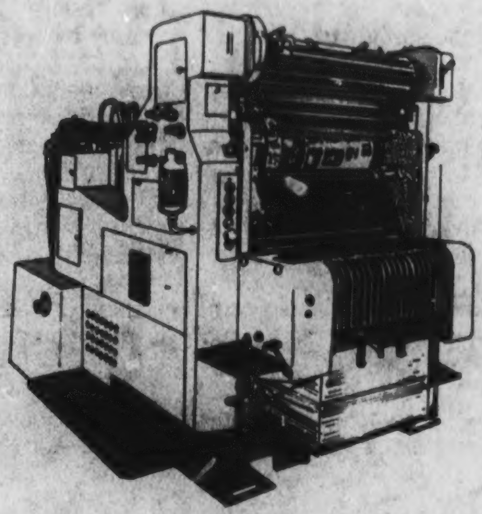


## INFORMATION SHEET

B. Photography — The process of producing images on a sensitized surface (film) by the action of radiant energy. Exposed film is processed to produce a negative; then prints are made from the negatives using a photographic enlarger in a darkroom.



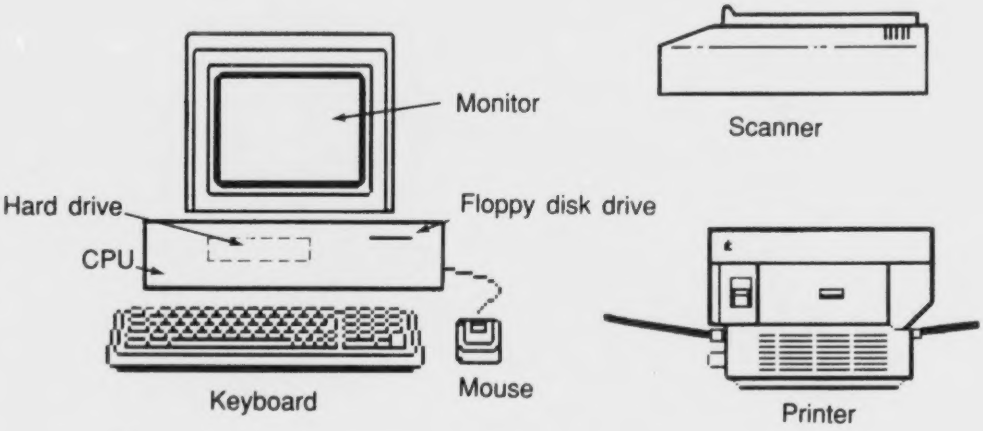
C. Printing — Method of reproducing large quantities of visual messages using specially prepared image carriers, mechanical presses, and ink or dye onto paper



## INFORMATION SHEET

D. Desktop publishing — Uses a personal computer system and appropriate software which combines text and graphics to produce a publication. The basic system includes a computer, software (publishing, graphics, and word processing), mouse, scanner, and laser printer.

(NOTE: One person can do all jobs to put together a publication.)



III. **Methods of producing and transmitting audio and audiovisual messages**

A. Telephone — An audio communication system that converts sound into electrical impulses for transmission primarily by wire.

(NOTE: Telephone companies have been major contributors in the development of laser, microwave, satellite, and fiberoptic transmission methods. These new methods provide high-quality, lower-cost long-distance transmission of signals.)

B. Radio — An audio communication system that converts sound into electrical impulses for wireless transmission by means of electromagnetic waves.

C. Recorded media — An audio communication device that stores audio signals on a variety of plastic media such as phonograph records, cassettes, and compact disks.

D. Television — A complex communication system using cameras, microphones, monitors, controls, and computers to record and transmit audio **and** video messages.

E. Computer — An electronic device used to store, retrieve, and process information (data). Can be used to organize, manipulate, and transmit audio and video messages.

## INFORMATION SHEET

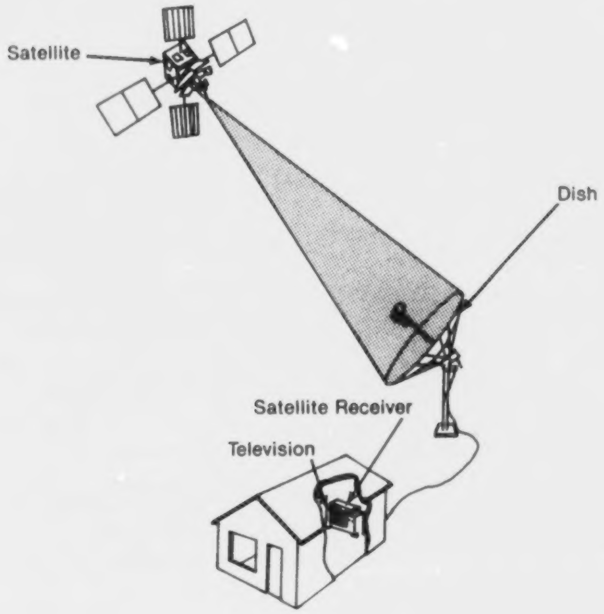
### IV. Emerging communication transmission technologies

A. Lasers — Transmit signals (messages) through the atmosphere using coherent electromagnetic radiation; do not use mechanical devices, fluids, or electrical wires.

(NOTE: The word laser comes from **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation.)

B. Microwaves — Wireless method of sending signals over a long distance using short electromagnetic waves (microwaves).

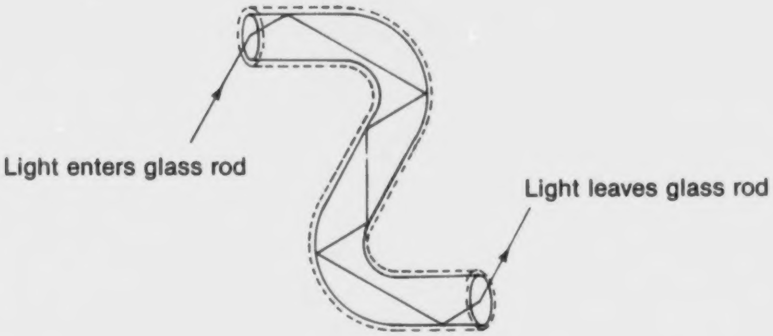
C. Satellites — Man-made objects that orbit the earth that are used by telephone and television networks to receive and transmit audio and video messages over great distances. A satellite dish is required to receive the signals.



## INFORMATION SHEET

D. Fiberoptics -- Transmit light through thin transparent fibers of glass or plastic.

(NOTE: Cables made up of these fiberoptic strands are being used more commonly by telephone companies because they take less space than traditional copper cables and also carry a greater number and better quality of calls.)

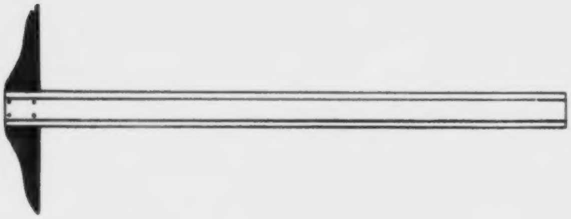


**Light Transmitted
by Internal Reflection**

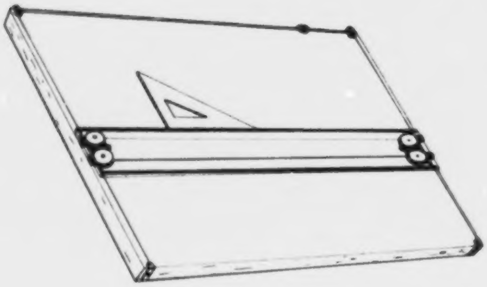
V. **Basic drafting tools and equipment**

A. Manual drafting tools

1. T-square or parallel bar — Used for drawing horizontal lines



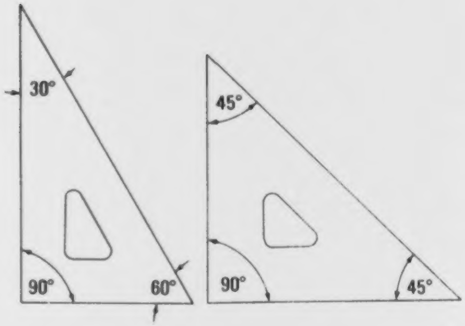
**T-Square**



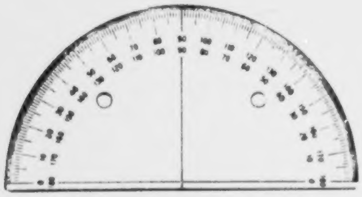
**Parallel Bar**

## INFORMATION SHEET

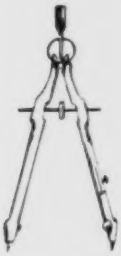
2. Triangles — Used for drawing vertical and inclined lines



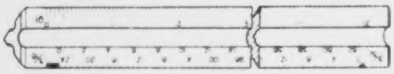
3. Protractor — Used to measure angles



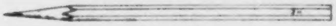
4. Compass — Used to draw circles and arcs



5. Scales — Used to measure the length of a line



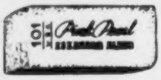
6. Pencils — Used to make graphite lines



**Wooden**

**Mechanical**

7. Erasers — Used to remove graphite lines and smudges



**Eraser**

8. Drafting media — Used as a base for drawing

Examples: Drawing paper, vellum, polyester film

## INFORMATION SHEET

B. Computer-aided drafting (CAD) equipment (hardware)

(NOTE: A CAD system has three essential features: people who use the system, the hardware, and the software.)

1. Input devices

   Examples: Digitizer, graphic tablet, light pen, keyboard, mouse

2. Information processing unit (IPU)

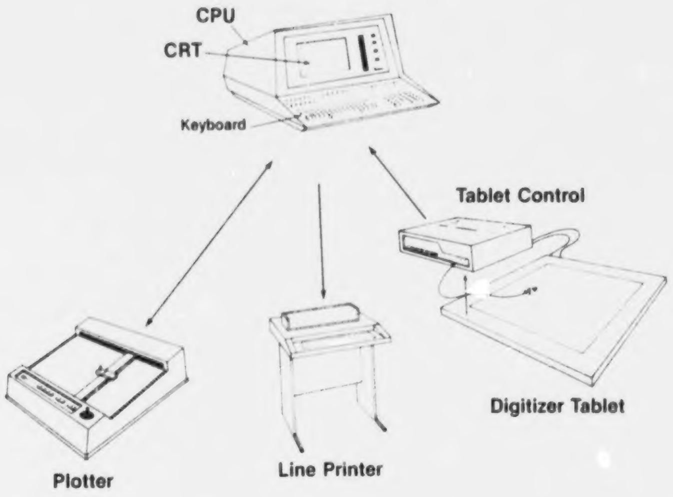
   Examples: Mainframe, minicomputer, microcomputer, terminal to mainframe

3. Memory recording and storage devices

   Examples: Floppy disk drive, hard disk drive, magnetic tapes

4. Output devices

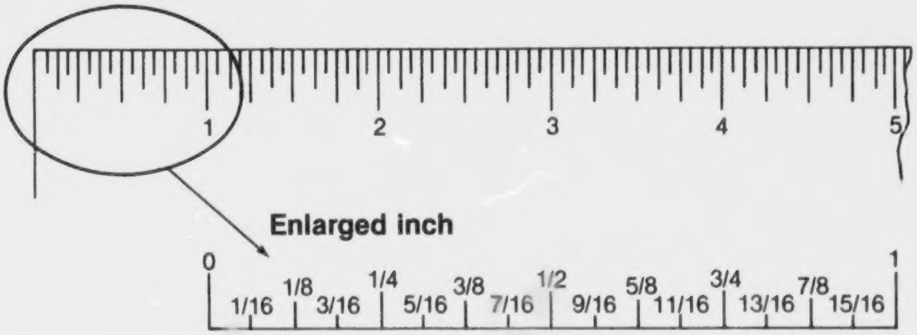
   Examples: Plotter, printer, CRT (for immediate visual output), photographic equipment


CPU
CRT
Keyboard
Tablet Control
Digitizer Tablet
Plotter
Line Printer

## INFORMATION SHEET

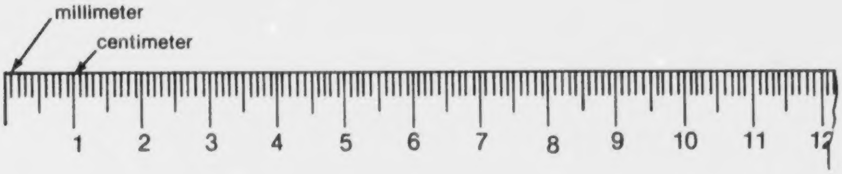
### VI. Systems of measurement

A. U.S. customary system — In this system the scale is divided into 1/16, 1/8, 1/4, 1/2, and full inch divisions.


1
2
3
4
5
Enlarged inch
0
1
1/8
1/4
3/8
1/2
5/8
3/4
7/8
1/16
3/16
5/16
7/16
9/16
11/16
13/16
15/16

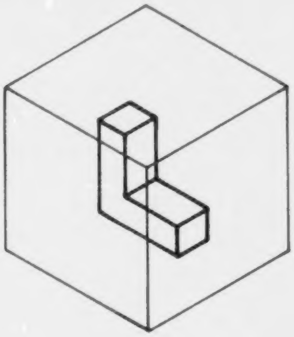
B. International system of metric measurement (SI metrics) — In this system the scale is divided into millimeters and centimeters.

(NOTE: Ten millimeters equal one centimeter. The metric system is based on powers of ten.)


millimeter
centimeter
1
2
3
4
5
6
7
8
9
10
11
12

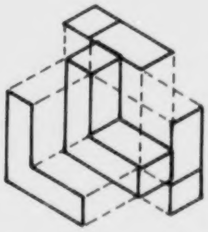
### VII. Multiview drawing (orthographic projection)

A. Imagine an object inside a glass box.

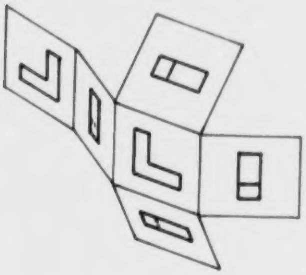


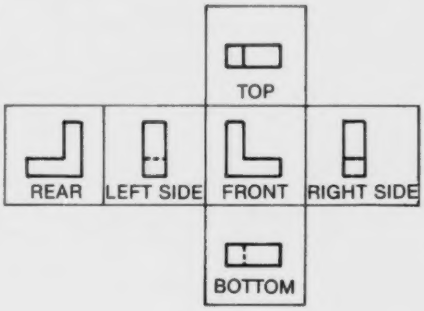
## INFORMATION SHEET

B. Project the surfaces of the object onto the sides of the box.



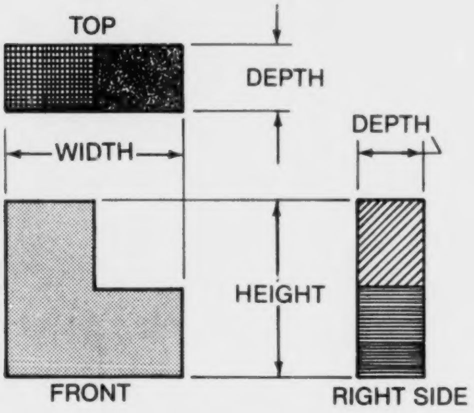
C. Unfold the glass box and lay it flat. You can now see all six sides.

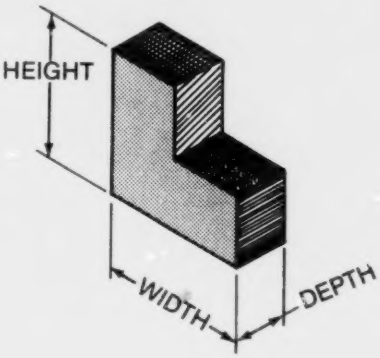



TOP
REAR
LEFT SIDE
FRONT
RIGHT SIDE
BOTTOM

(NOTE: Although six sides are possible, only three are commonly used in multiview drawing.)

D. Choose the principal views that show the width, height, and depth of the object. These views will usually be the front, top, and right side.


TOP
DEPTH
DEPTH
WIDTH
HEIGHT
FRONT
RIGHT SIDE


HEIGHT
WIDTH
DEPTH

## PRODUCING AND TRANSMITTING MESSAGES
## UNIT B-3

### ASSIGNMENT SHEET #1—READ UNITS OF MEASUREMENT

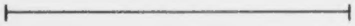
Name ______________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Lines are measured correctly | ______ |
| Assignment is neat and completed on time | ______ |

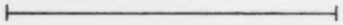
Directions: Measure the distances (A-E) between the markers on the lines below. Record your readings in the boxes.

(NOTE: Reduce fractions as needed. For example, 4/16" should be written 1/4".)

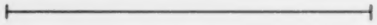
A



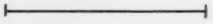
B



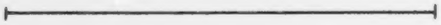
C



D



E



| | U.S. Customary (inch) | SI Metric (mm) |
|---|---|---|
| A. | | |
| B. | | |
| C. | | |
| D. | | |
| E. | | |
| | | |

## PRODUCING AND TRANSMITTING MESSAGES
## UNIT B-3

### ASSIGNMENT SHEET #2—MAKE A THREE-VIEW SKETCH

Name ______________________________ Overall Rating ____________

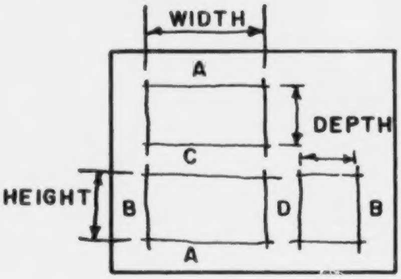
| EVALUATION CRITERIA | RATING |
|---|---|
| Views are drawn correctly | ______ |
| Assignment is neat and completed on time | ______ |

Directions: Study the example below and then complete the assigned problem.

Example:

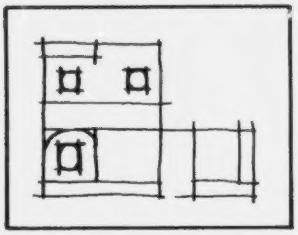
1. Sketch the horizontal lines to locate the height of the object.

   (NOTE: The distance at the top and bottom of the paper should be the same. The distance between the top and front views can be the same as that on the top and bottom or slightly less than that space.)

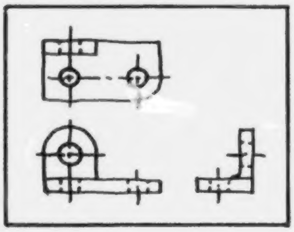


2. Sketch the vertical lines to locate the width and depth of the object.

   (NOTE: The distance at the left side and right side of the paper should be the same. The distance between the views can be the same as that on the left side and right side or slightly less than that space. In the top and side views, the depth must be equal; this can be done by marking a piece of paper with depth.)



3. Block in details using diagonals to locate centers, if necessary, and lightly sketch the circles and arcs.

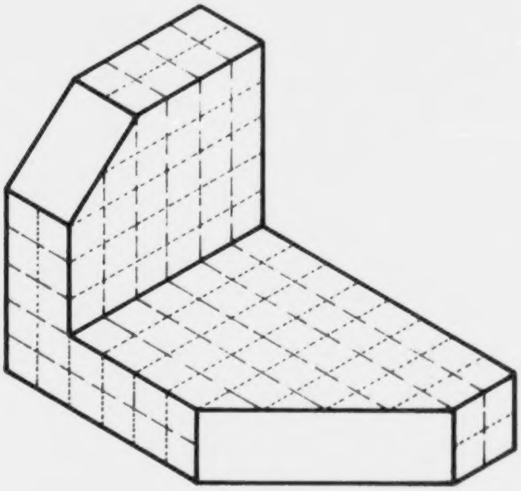


4. Add line features to the views of the object.

5. Use an eraser to dim construction lines and darken in visible lines.

## ASSIGNMENT SHEET #2

Problem: Sketch three views of the object below using the grid provided for measurements or gridded drawing media if requested by instructor.



## PRODUCING AND TRANSMITTING MESSAGES
## UNIT B-3

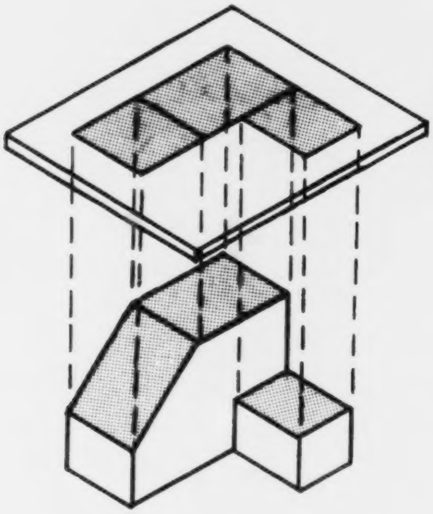
## ASSIGNMENT SHEET #3—COMPLETE MULTIVIEW DRAWINGS

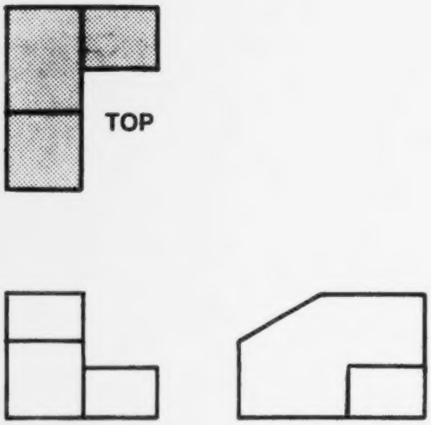
Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Views are drawn correctly | ______ |
| Assignment is neat and completed on time | ______ |

Directions: Study the examples below which show how to imagine the needed views projected to a plane. Then complete the assigned problems.

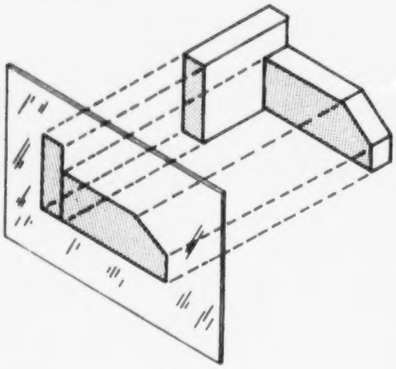
Example:

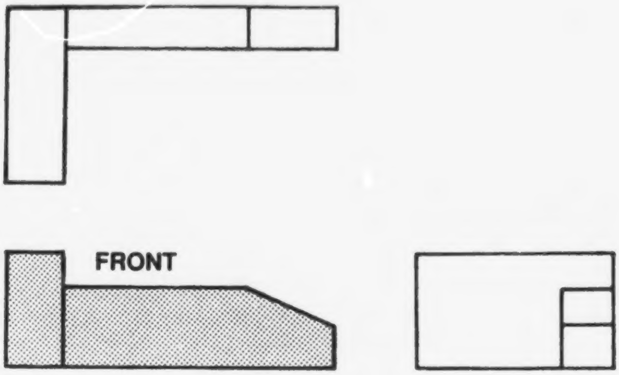




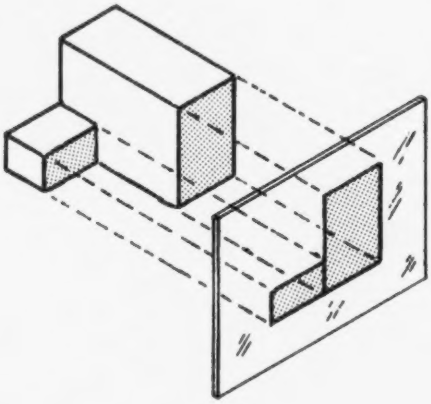
## ASSIGNMENT SHEET #3

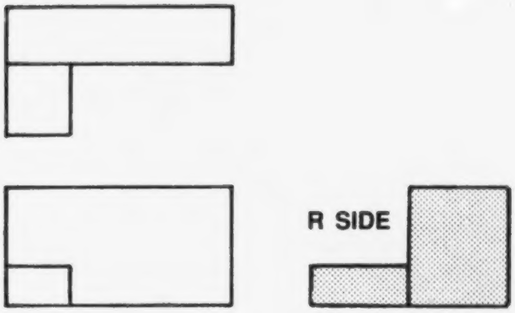
Example:





Example:

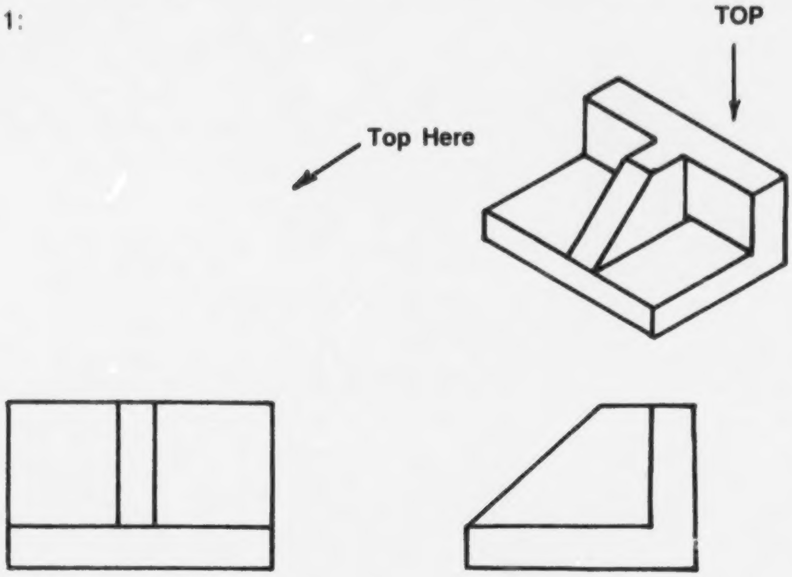




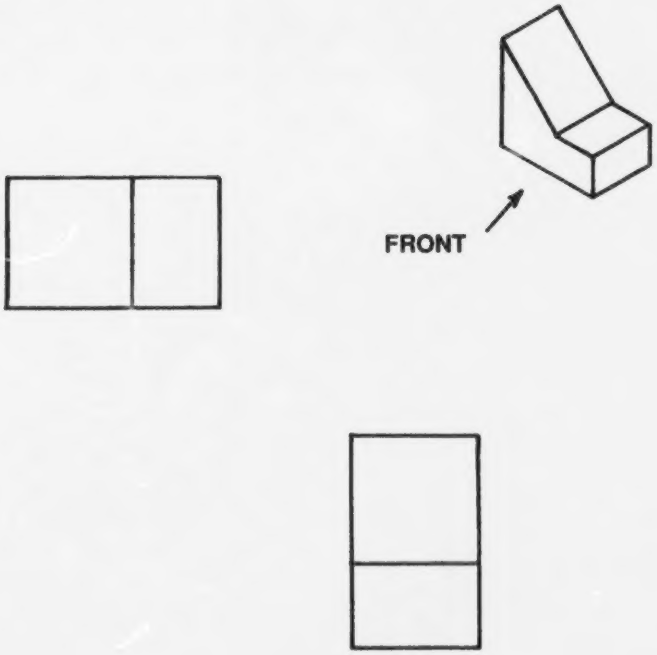
## ASSIGNMENT SHEET #3

Problems: Construct the missing views required. Use appropriate drafting tools.

Problem 1:

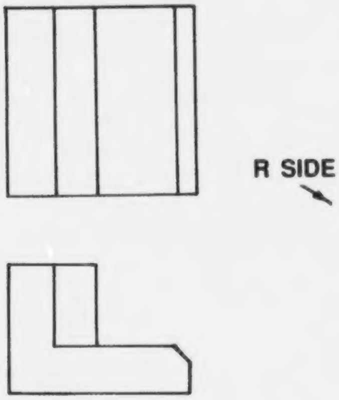

TOP
Top Here

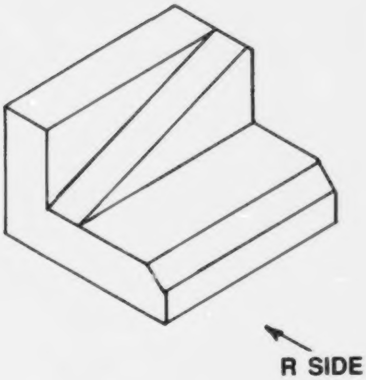
Problem 2:



## ASSIGNMENT SHEET #3

Problem 3:





# PRODUCING AND TRANSMITTING MESSAGES
## UNIT B-3

## ASSIGNMENT SHEET #4—PRODUCE AND TRANSMIT A VISUAL MESSAGE

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Message is produced correctly | _____ |
| Message is transmitted correctly | _____ |
| Assignment is neat and completed on time | _____ |

(NOTE: This assignment should correspond to the project selected in Units B-1 and B-2.)

Directions: Use the rough sketches developed in the previous unit to now produce and transmit your visual message. Discuss with your instructor the equipment and supplies needed.

(NOTE: Your message may be produced and transmitted through manual or computer-aided drafting, photography, printing methods, or desktop publishing.)

## PRODUCING AND TRANSMITTING MESSAGES
## UNIT B-3

### ASSIGNMENT SHEET #5—PRODUCE AND TRANSMIT AN AUDIO OR AUDIOVISUAL MESSAGE

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Message is produced correctly | ______ |
| Message is transmitted correctly | ______ |
| Assignment is neat and completed on time | ______ |

(NOTE: This assignment should correspond to the project selected in Units B-1 and B-2.)

Directions: Use the storyboard and script developed in the previous unit to now produce and transmit your audio or audiovisual message. Discuss with your instructor the equipment and supplies needed.

(NOTE: Your message may be produced and transmitted live as oral presentations or skits or may be recorded on audio or video tapes.)

## PRODUCING AND TRANSMITTING MESSAGES
## UNIT B-3

## ANSWERS TO ASSIGNMENT SHEETS

**Assignment Sheet #1**

A. 2" or 51 mm

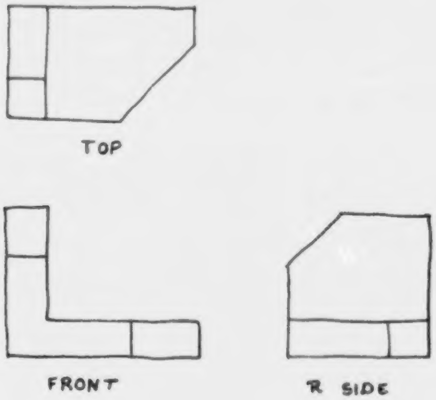
B. $1\frac{15}{16}$" or 49 mm

C. $2\frac{1}{8}$" or 54 mm

D. $1\frac{3}{16}$" or 30 mm

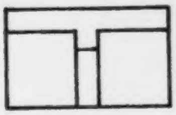
E. $2\frac{1}{2}$" or 64 mm

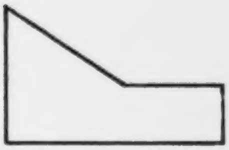
**Assignment Sheet #2**

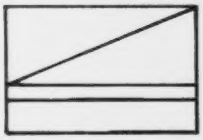


## ANSWERS TO ASSIGNMENT SHEETS

**Assignment Sheet #3**

1. 

2. 

3. 

**Assignment Sheets #4 and #5** — Evaluated according to the stated criteria

# PRODUCING AND TRANSMITTING MESSAGES
## UNIT B-3

## LAB ACTIVITY SHEET #1—CONSTRUCT AND DEMONSTRATE A FIBEROPTIC SIMULATOR

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Simulator is well-constructed | ______ |
| Message is sent by code | ______ |
| Descriptions of procedure and improvements are appropriate | ______ |

A. Equipment and supplies:

1. Clear cast acrylic rod (1/4" dia., 12" long)
2. Electrical tape
3. Ordinary 2-cell flashlight
4. Piece of wood (3/4" x 2" x 2")
5. Drill press
6. Bandsaw
7. Safety equipment

B. Procedure:

1. Put on safety glasses.
2. Obtain permission from your instructor before operating the equipment.
3. Cut the acrylic rod to 12" long using the band saw.
4. Cut the piece of wood to 3/4" x 2" x 2" if needed using the band saw.
5. Drill a 1/4" hole in the center of the wood using the drill press
6. Polish the ends of acrylic rod until they are transparent.
7. Place one end of acrylic rod into hole in the piece of wood.
8. Attach flashlight to piece of wood with electrical tape.
9. Turn on flashlight and look at the light coming through the clear rod.

## LAB ACTIVITY SHEET #1

C. Fiberoptic simulator applications:

1. Write a short message.
2. Develop your own code or use the Morse code to send the message through the fiberoptic simulator.
3. Describe your message and the code you used below.

4. How would you improve the communication?

## PRODUCING AND TRANSMITTING MESSAGES
## UNIT B-3

### TEST

Name ______________________________ Score ________________

1. Match the terms on the right with the correct definitions.

_____a. An electronic device that converts printed text and graphics into electric images that can be read by a computer

_____b. Set of numbers that locate a point on a line, on a surface, or in space

_____c. Recording of audio and video messages on a magnetic cassette tape

_____d. Words used to present information

_____e. Using a computer to create or modify designs and drawings

_____f. The process of describing an object by drawing several views of that object

1. CAD and CADD
2. Coordinates
3. Desktop publishing
4. Graphics
5. Multiview drawing
6. Plotter
7. Scale drawing
8. Scanner
9. Text
10. Videodisk
11. Videotape

2. Complete the following statements concerning the methods of producing and transmitting visual messages by circling the correct words.

a. (**Printing, Drafting**) is called the universal language of industry and modern technology.

b. (**Printing, Photography**) is the process of producing images on a sensitized surface (film) by the action of radiant energy. Exposed film is processed to produce a negative; then prints are made from the negatives using an enlarger in a darkroom.

c. (**CAD, Manual**) drafting uses tools such as triangles, T-squares, and protractors.

d. Desktop publishing uses a (**mainframe, personal**) computer system and appropriate software which combines text and graphics to produce a publication.

## TEST

3. Match methods of producing and transmitting audio and audiovisual messages with the correct descriptions.

_____a. An audio communication system that converts sound into electrical impulses for transmission primarily by wire

_____b. An audio communication system that converts sound into electrical impulses for wireless transmission by means of electromagnetic waves

_____c. A complex communication system using cameras, microphones, monitors, controls, and computers to record and transmit audio and video messages

_____d. An electronic device used to store, retrieve, and process information (data). Can be used to organize, manipulate, and transmit audio and video messages

1. Computer
2. Lasers
3. Radio
4. Telephone
5. Television

4. Match emerging communication transmission technologies with the correct descriptions.

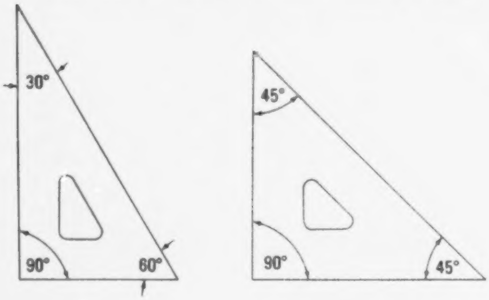
_____a. Transmit signals through the atmosphere using coherent electromagnetic radiation; do not use mechanical devices, fluids, or electrical wires

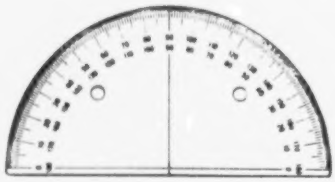
_____b. Transmit light through thin transparent fibers of glass or plastic

_____c. Man-made objects that orbit the earth that are used to receive and transmit audio and video messages over great distances

1. Fiberoptics
2. Lasers
3. Microwaves
4. Radar
5. Satellites

5. Identify the following basic drafting tools and equipment.

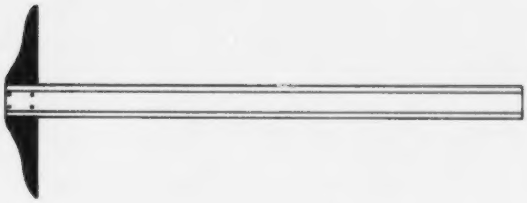




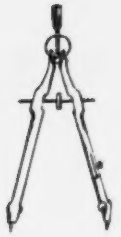
a. ____________________________

b. ____________________________

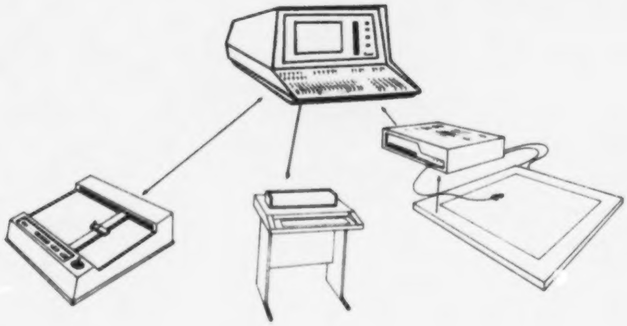
## TEST



c. ______________________________



d. ______________________________



e. ______________________________

6. Distinguish between the systems of measurement by placing an "X" next to the description of the U.S. customary system.

   _____a. Scale is divided into 1/16, 1/8, 1/4, 1/2, and full inch divisions

   _____b. Scale is divided into millimeters and centimeters

7. Select true statements concerning multiview drawing by placing a "T" or "F" next to the true or false statements.

   _____a. The principal views in multiview drawing show the width, depth, and thickness of an object.

   _____b. The principal views of an object are usually the front, top, and right side.

   _____c. If you project the views of an object onto the sides of an imaginary glass box, you could visualize eight views.

## TEST

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

8. Read units of measurement. (Assignment Sheet #1)
9. Make a three-view sketch. (Assignment Sheet #2)
10. Complete multiview drawings. (Assignment Sheet #3)
11. Produce and transmit a visual message. (Assignment Sheet #4)
12. Produce and transmit an audio or audiovisual message. (Assignment Sheet #5)
13. Construct and demonstrate a fiberoptic simulator. (Lab Activity Sheet #1)

## PRODUCING AND TRANSMITTING MESSAGES
## UNIT B-3

### ANSWERS TO TEST

1. a. 8
   b. 2
   c. 11
   d. 9
   e. 1
   f. 5

2. a. Drafting
   b. Photography
   c. Manual
   d. Personal

3. a. 4
   b. 3
   c. 5
   d. 1

4. a. 2
   b. 1
   c. 5

5. a. Triangles
   b. Protractor
   c. T-square
   d. Compass
   e. CAD system

6. a

7. a. F
   b. T
   c. F

8-13. Evaluated to the satisfaction of the instructor

# EVALUATING MESSAGES
## UNIT B-4

## UNIT OBJECTIVE

After completion of this unit, the student should be able to evaluate messages and the communication organization. Competencies will be demonstrated by completing the assignment sheet and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to evaluating messages with the correct definitions.
2. Select from a list the parts of a message to evaluate.
3. Discuss the importance of feedback.
4. List the forms of feedback.
5. List examples of feedback.
6. Evaluate the communication organization. (Assignment Sheet #1)

## EVALUATING MESSAGES
## UNIT B-4

### SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make a transparency from the transparency master included with this unit. This appears in the teacher edition only and is designed to be used with the following objective:

TM 1 — Examples of Feedback — Objective 5

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. Use Teacher Supplement #1 to present AIT video B-4. This video was developed by the Agency for Instructional Technology (AIT) and a consortium of states to accompany this publication. Contact your state supervisor of technology education for copies, or contact AIT directly for more information:

   Agency for Instructional Technology (AIT)
   Box A, Bloomington, IN 47402
   (800)457-4509 or (812)449-2203

2. Use Teacher Supplements #2 and #3 to help students understand this unit's terminology. Make copies (fronts only) for your students. The answers are on the backs of the supplements.

3. Use this unit to wrap up activities in all areas.

4. Use the evaluation and wrap-up to find the special interest areas the students have developed. Plan to build on this interest in future activities.

5. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

## SUGGESTED ACTIVITIES

H. Administer test.

I. Evaluate test.

J. Reteach if necessary.

## REFERENCES USED IN DEVELOPING THIS UNIT

A. Barden, Robert and Michael Hacker. *Living with Technology*. Albany, NY: Delmar Publishers Inc., 1988.

B. Smith, H.B. and R. Thomas Wright. *Understanding Technology*. South Holland, IL: Goodheart-Wilcox Co., Inc., 1988.

C. Hauenstein, A. Dean and Steven A. Bachmeyer. *The World of Communications: Audiovisual Media*. Bloomington, IL: McKnight Publishing Co., 1975.

D. Jones, Ronald E. and Janet L. Robb. *Discovering Technology Communication*. Dallas, TX: Harcourt Brace Jovanovich Publishers, 1986.

E. Suggested Supplemental Resource — Videotape entitled *Evaluating Messages, Unit B-4; Exploring Technology Education* series. Available from:

Agency for Instructional Technology
Box A
Bloomington, IN 47402
800-457-4509

# EVALUATING MESSAGES
## UNIT B-4

## TEACHER SUPPLEMENT #1—USING AIT VIDEO B-4

### Introduction and Program Summary (12:22)

This video program focuses on the importance of feedback in the communication process and how technology has improved the transmission of this feedback. It opens with an image of the SETI antenna, a radio transmitter to outer space, and moves to a scene in which a teenager tries to order a hamburger at a drive-in restaurant with an unintelligible intercom. There is a lack of clear or adequate feedback in each case. *USA Today* and the Live Aid concert have been successful at receiving feedback, but the pilot whose plane hit the Empire State Building raised no response to his calls for help. When the Apollo 13 flight was in danger, feedback from Mission Control provided the astronauts with the help they needed to land safely.

Technology brings about ever faster communication and feedback. The movement of mail reflects major technological improvements in transportation, manufacturing, and energy. Now express mail centers can process huge volumes of mail so that they will arrive the day after they have been sent. Boy Scouts using computers with modems can transmit articles for their newsletter instantaneously. A disc jockey on a rock radio program describes how important it is to find ways of getting feedback from his invisible audience. Rating services supply feedback for radio and television broadcasters. The program ends with a request from the producers of the **Exploring Technology Education** video programs for viewers to send **them** feedback about the programs. (Send feedback to AIT, Box A, Bloomington, IN 47402.)

### Video Program Objectives

The video program will illustrate that

- In communication, feedback is necessary to determine whether a message is received
- There are many different methods and devices used for obtaining feedback in all areas of communication technology
- Technology provides greater quantities of feedback more quickly and accurately than ever before

### Before the Program

1. Tell your students this program describes a few representative examples of feedback and evaluation and their importance in the communication model. The video illustrates the importance of feedback by showing real life incidents in which feedback meant the difference between life and death. Explain that evaluation and feedback are necessary for us to know if the message has gotten through and how well people understand it. Ask your students how feedback is used in schools, and ask them to give examples. (Encourage students to mention homework assignments, questions, and tests. Note that these are only a few examples, and that feedback and evaluation are going on all around us.) The program also shows how feedback has been improved and what that means to all of us.

## TEACHER SUPPLEMENT #1

2. Relate what the students will see in the program to activities they have done and will be doing in the lab.

3. Tell students to note the following terms and careers that are mentioned in the video program. (You might write them on the chalkboard.)

**Terms**

SETI (Search for Extraterrestrial Intelligence
opinion surveys
express mail
questionnaire
modem
ratings service

**Careers**

disc jockey
NASA engineer
mail courier
astronaut

### After the Program: Questions for Discussion and Review

1. What is feedback? (*the reaction or reply to a message; how people respond to the message)* Why is it necessary to have feedback in communication technology? (*to evaluate the effectiveness of a message; to give continuing direction, correction, and even avoid tragedy as in the case of the astronauts)*

2. Give an example of feedback, describing methods used to provide feedback and evaluate messages that were shown in the video. (*Money contributed after the Live Aid concert showed that the message had been received and that it had elicited a response. Engineers at Mission Control were able to respond to the astronauts' messages and give the feedback that corrected the problems on the rocket. TV and radio rating systems help broadcast companies stay in tune with their listeners' preferences.)*

3. List other methods of providing evaluation and feedback to messages not seen in the video. (*Students may suggest feedback from all sorts of areas. Homework correction and grading, applause after a performance, letters to the editor, political and other polls, computer-generated messages or movements in games or programs —these are all examples of feedback. Students may go on to point out, quite correctly, that the feedback from one message may become a new message generating new feedback: a politician's response to a poll may cause a change in a campaign ad with a new message.)*

4. How have feedback and evaluation been improved in recent years? What has been the effect in changing the way people have lived throughout history? (*Improvements in the speed and efficiency with which messages can be transmitted and in which feedback can be returned have brought people steadily closer together. Actions and events in widely separated areas of the globe now have almost immediate effects on each other.)*

## TEACHER SUPPLEMENT #1

5. How can feedback be improved in the future? (*Instant rating systems for media events, videophones, ways of instantly and continually monitoring the effect of experimental drugs, increasingly sophisticated cameras that immediately let you see what you have filmed, and possible development of communication with outer space and nonhuman creatures may enable all beings to affect and respond to others continually.*) What effect will it have on the way we will live? (*Instantaneous feedback may correct mistakes or problems before they become severe. It may also encourage changes too quickly, before long-range results are known: new television programs are often discontinued after a single showing before they have time to build an audience.*)

## EVALUATING MESSAGES
## UNIT B-4

### TEACHER SUPPLEMENT #2—CROSSWORD PUZZLE

Name ______________________________ Date ____________________

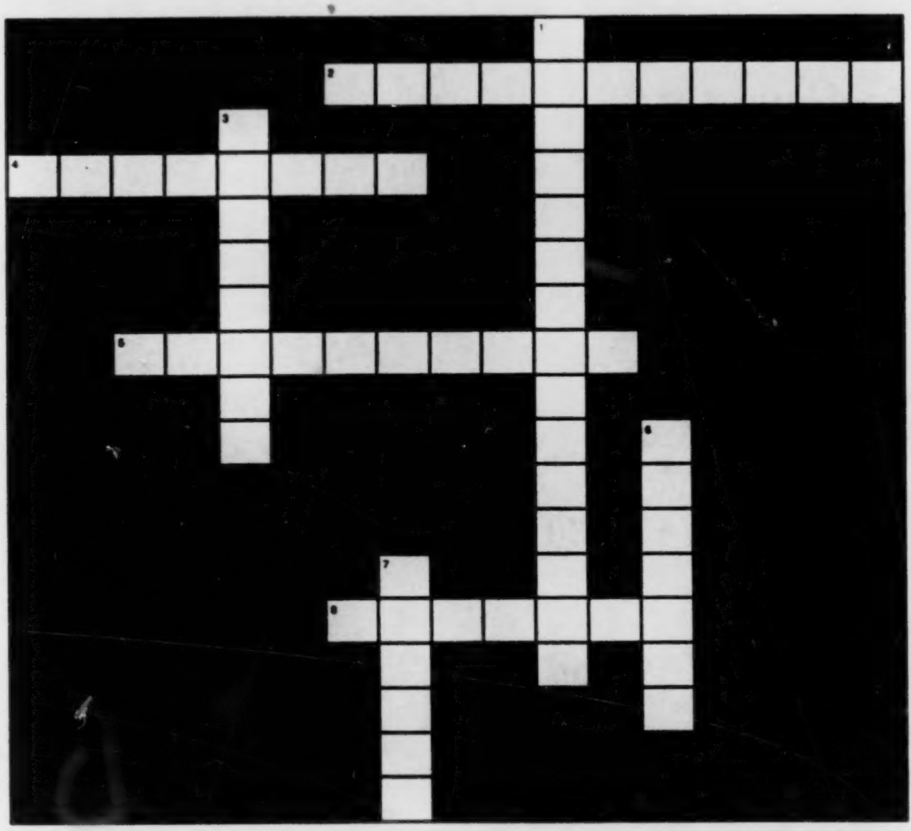
Directions: Use the clues below to solve the crossword puzzle.

Across

2. A visual example of feedback
4. Evaluating messages according to groups of people
5. The process of judging value or worth
8. Evaluating messages according to information provided

Down

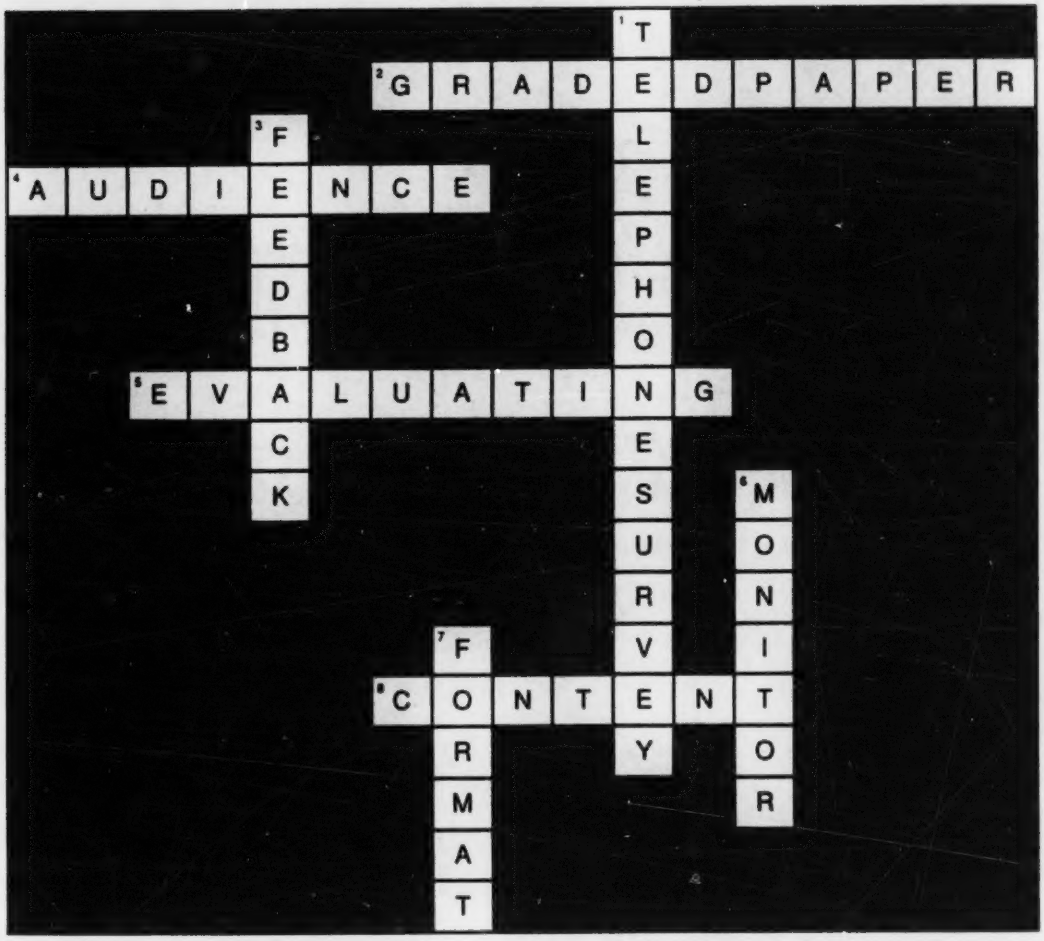
1. An audio example of feedback
3. Reaction or reply to a message
6. To observe the output of a system
7. Evaluating messages according to appearance



*Duplication Permitted*

## TEACHER SUPPLEMENT #2

## CROSSWORD PUZZLE ANSWER KEY


1 TELEPHONE SURVEY
2 GRADED PAPER
3 FEEDBACK
4 AUDIENCE
5 EVALUATING
6 MONITOR
7 FORMAT
8 CONTENT

# EVALUATING MESSAGES
## UNIT B-4

## TEACHER SUPPLEMENT #3—WORD SEARCH

Name ______________________________ Date ____________________

Directions: Find the words below hidden in the puzzle. Circle the words that you find.

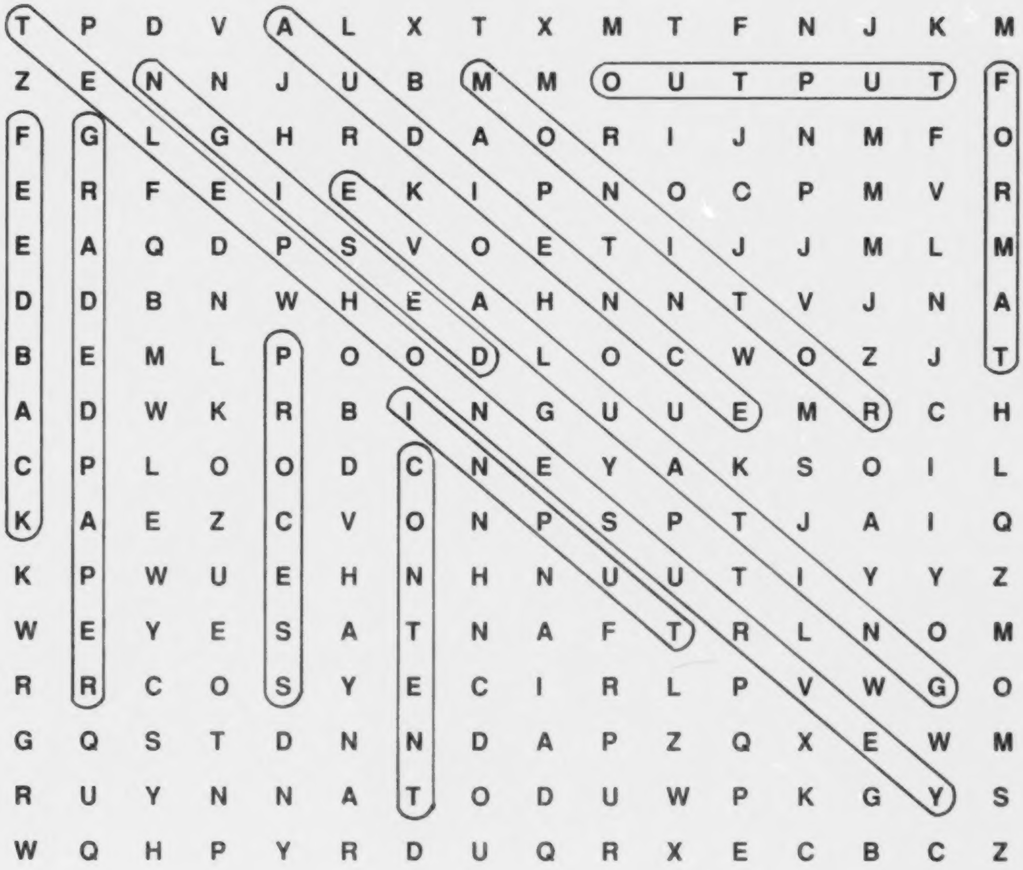
TELEPHONE SURVEY
MONITOR
INPUT
GRADED PAPER
PROCESS
FORMAT
EVALUATING
CONTENT
FEEDBACK
OUTPUT
AUDIENCE
DESIGN

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T | P | D | V | A | L | X | T | X | M | T | F | N | J | K | M |
| Z | E | N | N | J | U | B | M | M | O | U | T | P | U | T | F |
| F | G | L | G | H | R | D | A | O | R | I | J | N | M | F | O |
| E | R | F | E | I | E | K | I | P | N | O | O | P | M | V | R |
| E | A | Q | D | P | S | V | O | E | T | I | J | J | M | L | M |
| D | D | B | N | W | H | E | A | H | N | N | T | V | J | N | A |
| B | E | M | L | P | O | O | D | L | O | C | W | O | Z | J | T |
| A | D | W | K | R | B | I | N | G | U | U | E | M | R | C | H |
| C | P | L | O | O | D | C | N | E | Y | A | K | S | O | I | L |
| K | A | E | Z | C | V | O | N | P | S | P | T | J | A | I | Q |
| K | P | W | U | E | H | N | H | N | U | U | T | I | Y | Y | Z |
| W | E | Y | E | S | A | T | N | A | F | T | R | L | N | O | M |
| R | R | C | O | S | Y | E | C | I | R | L | P | V | W | G | O |
| G | Q | S | T | D | N | N | D | A | P | Z | Q | X | E | W | M |
| R | U | Y | N | N | A | T | O | D | U | W | P | K | G | Y | S |
| W | Q | H | P | Y | R | D | U | Q | R | X | E | C | B | C | Z |

*Duplication Permitted*

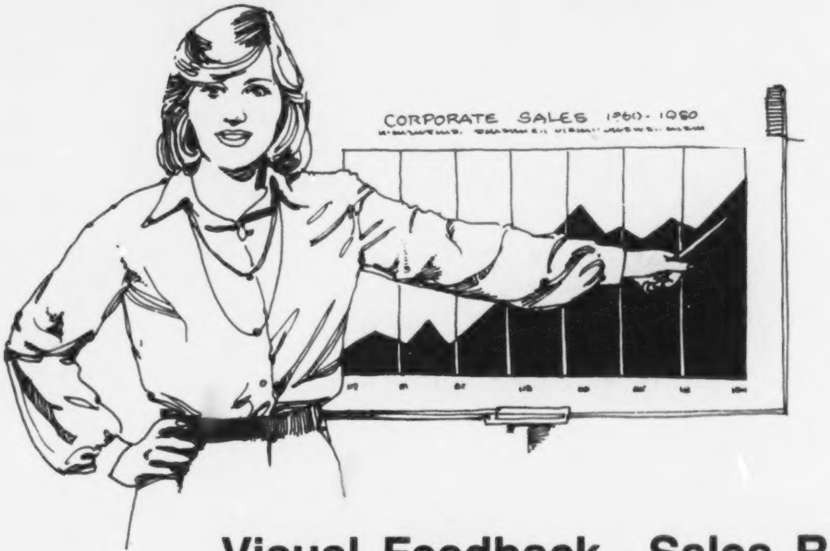
## TEACHER SUPPLEMENT #3

## WORD SEARCH ANSWER KEY

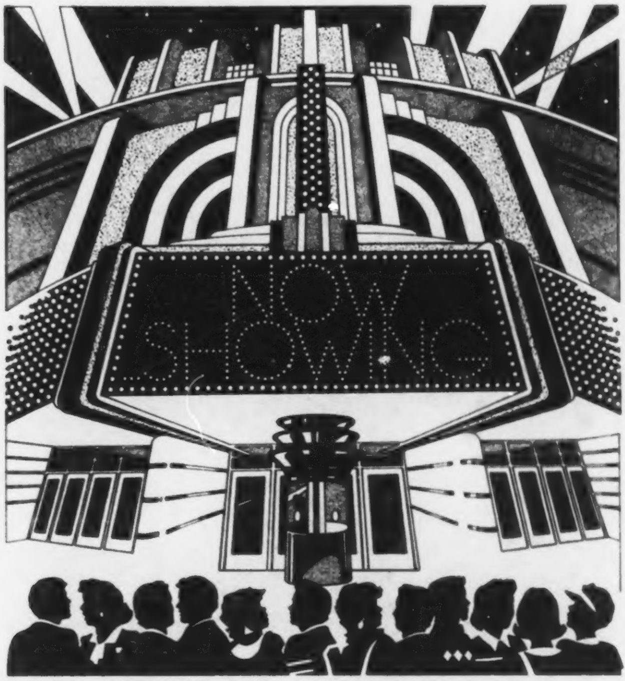


| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T | P | D | V | A | L | X | T | X | M | T | F | N | J | K | M |
| Z | E | N | N | J | U | B | M | M | O | U | T | P | U | T | F |
| F | G | L | G | H | R | D | A | O | R | I | J | N | M | F | O |
| E | R | F | E | I | E | K | I | P | N | O | C | P | M | V | R |
| E | A | Q | D | P | S | V | O | E | T | I | J | J | M | L | M |
| D | D | B | N | W | H | E | A | H | N | N | T | V | J | N | A |
| B | E | M | L | P | O | O | D | L | O | C | W | O | Z | J | T |
| A | D | W | K | R | B | I | N | G | U | U | E | M | R | C | H |
| C | P | L | O | O | D | C | N | E | Y | A | K | S | O | I | L |
| K | A | E | Z | C | V | O | N | P | S | P | T | J | A | I | Q |
| K | P | W | U | E | H | N | H | N | U | U | T | I | Y | Y | Z |
| W | E | Y | E | S | A | T | N | A | F | T | R | L | N | O | M |
| R | R | C | O | S | Y | E | C | I | R | L | P | V | W | G | O |
| G | Q | S | T | D | N | N | D | A | P | Z | Q | X | E | W | M |
| R | U | Y | N | N | A | T | O | D | U | W | P | K | G | Y | S |
| W | Q | H | P | Y | R | D | U | Q | R | X | E | C | B | C | Z |

# Examples of Feedback


CORPORATE SALES 1960 - 1980

Visual Feedback—Sales Report


NOW SHOWING

Audiovisual Feedback—Good Ticket Sales and Applause

TM 1

# EVALUATING MESSAGES
## UNIT B-4

## INFORMATION SHEET

I. **Terms and definitions**

A. Evaluating — The process of judging the worth or value of something

B. Feedback — The reaction or reply to a message; used to evaluate the effectiveness of a message

(NOTE: All evaluations are based upon feedback.)

C. Monitor — To observe the output of a system

D. Ratings — An estimate of the percentage of the public listening to or viewing a particular radio or television program

E. Survey — Asking individuals (consumers) specific questions about products or services so data (their answers) can be analyzed

II. **Parts of a message to evaluate**

A. **Audience** — Is message targeted to correct group? Does product or service appeal to them?

B. **Content** — Is message clear and interesting? Is it written at the correct level?

C. **Format** — Does message reach intended audience? Is its appearance pleasing?

Example: If you are trying to sell a new videogame to young teens by using an advertisement in a teen magazine, but sales are low, you have to evaluate the audience, content, and format of your message. Many things could have gone wrong such as the videogame was really written for 8-year-olds, the advertisement was boring or deceptive, or the majority of readers of that teen magazine do not buy video games. The message will have to be redesigned.

III. **Importance of feedback**

A. Input — Feedback provides information about the value or quality of the message content

Example: If someone gives incorrect directions on how to get to a place, then the input was faulty.

B. Process — Feedback provides information about the method of message design or transmission

Example: If someone gives correct directions to a place, but they speak unclearly, the process was faulty.

## INFORMATION SHEET

C. Output — Feedback provides information about the actual reaction to the message.

Example: If someone gives good directions to a place, but the person that received the message got lost, then the output was faulty.

**IV. Forms of feedback**

A. Expected, desirable

Example: Your semester grades were 4 A's and 2 B's. You expected your parents to be proud, and they were.

B. Expected, undesirable

Example: Your semester grades were 4 C's and 2 D's. You expected your parents to be disappointed, and they were.

C. Unexpected, desirable

Example: Your semester grades were 1 B, 4 C's, and 1 D. You expected your parents to be mad, but instead they said they knew school was hard and to just try harder.

D. Unexpected, undesirable

Example: Your semester grades were 4 A's and 2 B's. You expected your parents to be proud, but instead they were disappointed that you didn't make all A's.

**V. Examples of feedback**

A. Visual

1. Business and personal letters
2. Written surveys
3. Graded papers, report cards
4. Body language such as nods and facial expressions
5. Sales

B. Audio

1. Radio ratings
2. Telephone surveys

C. Audiovisual

1. Computerized surveys
2. Television ratings
3. Sales (box office)
4. Audience response such as applause or laughter

# EVALUATING MESSAGES
## UNIT B-4

### ASSIGNMENT SHEET #1 — EVALUATE THE COMMUNICATION ORGANIZATION

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Answers are appropriate | _____ |
| Assignment is neat and completed on time | _____ |

Directions: Evaluate your class's communication organization by answering the following questions.

1. Was the project well chosen? ______________________________
2. Was the information gathered during research correct? ____________
3. Did you make or lose money? ______________________________

   Why? ______________________________

   ______________________________
4. How was the majority of money spent? ______________________________

   ______________________________

   ______________________________
5. Did your customer like the product or service? ____________

   How do you know? How did you obtain their feedback? ____________

   ______________________________

   ______________________________
6. What changes would you make if you were starting again? ____________

   ______________________________

   ______________________________

   ______________________________

   ______________________________

## EVALUATING MESSAGES
## UNIT B-4

### TEST

Name ______________________________ Score ____________________

1. Match the terms on the right with the correct definitions.

_____a. An estimate of the percentage of the public listening to or viewing a particular radio or television program

_____b. The process of judging the worth or value of something

_____c. The reaction or reply to a message; used to evaluate the effectiveness of a message

_____d. Asking individuals specific questions about products or services so data can be analyzed

_____e. To observe the output of a system

1. Audience
2. Evaluating
3. Feedback
4. Monitor
5. Ratings
6. Survey

2. Select from the following list the three parts of a message to evaluate by placing an "X" next to the correct parts.

_____a. Content

_____b. Format

_____c. Style

_____d. Size

_____e. Audience

3. Discuss the importance of feedback.

## TEST

4. List two forms of feedback.

   *Example: Expected, desirable.*

   a. ____________________

   b. ____________________

5. List four examples of feedback.

   a. ____________________

   b. ____________________

   c. ____________________

   d. ____________________

(NOTE: If the following activity has not been accomplished prior to the test, ask your instructor when it should be completed.)

6. Evaluate the communication organization. (Assignment Sheet #1)

# EVALUATING MESSAGES
## UNIT B-4

## ANSWERS TO TEST

1. a. 5
   b. 2
   c. 3
   d. 6
   e. 4

2. a, b, e

3. Discussion should include the following: (Students may use examples to show importance of feedback.)

   a. Input — Feedback provides information about the value or quality of the message content.
   b. Process — Feedback provides information about the method of message design or transmission.
   c. Output — Feedback provides information about the actual reaction to the message.

4. Any two of the following:

   a. Expected, undesirable
   b. Unexpected, desirable
   c. Unexpected, undesirable

5. Any four of the following: (Students may give other examples.)

   a. Business and personal letters
   b. Surveys (written, telephone, or computerized)
   c. Graded papers, report cards
   d. Body language such as nods and facial expressions
   e. Sales
   f. Ratings (radio and television)
   g. Audience response such as applause or laughter

6. Evaluated to the satisfaction of the instructor

# INTRODUCTION TO CONSTRUCTION
## UNIT C-1

## UNIT OBJECTIVE

After completion of this unit, the student should be able to distinguish among the types of construction and research careers related to this field. Competencies will be demonstrated by completing the assignment sheets and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to construction with the correct definitions.
2. Distinguish among the major types of construction.
3. List purposes of construction.
4. Categorize the parts of the construction system model.
5. Discuss the interrelationship between construction and the other technology systems.
6. Distinguish between advantages and disadvantages of construction.
7. Match construction technology careers with the correct descriptions.
8. Identify the major types of construction in your community. (Assignment Sheet #1)
9. Research a construction technology career. (Assignment Sheet #2)

# INTRODUCTION TO CONSTRUCTION
## UNIT C-1

## SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make a transparency from the transparency master included with this unit. This appears in the teacher edition only and is designed to be used with the following objective:

TM 1 — Major Types of Construction — Objective 2

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

G. Integrate the following activities throughout the teaching of this unit:

1. Use Teacher Supplement #1 to present AIT video C-1. This video was developed by the Agency for Instructional Technology (AIT) and a consortium of states to accompany this publication. Contact your state supervisor of technology education for copies, or contact AIT directly for more information:

   Agency for Instructional Technology (AIT)
   Box A, Bloomington, IN 47402
   800-457-4509 or 812-339-2203

2. Use Teacher Supplements #2 and #3 to help students understand this unit's terminology. Make copies (fronts only) for your students. The answers are on the backs of the supplements.

3. Introduce unit by discussing planned activities and projects to create interest.

4. Reinforce types of construction by having students bring pictures or news articles of construction projects. Make a display board.

5. Encourage career research by inviting different construction employers/employees from the community to speak to the class.

6. Plan to use *School Shop* and other construction related publications as a resource while teaching these units.

7. Use TSA Competitive Events Guidelines format for research papers and construction technology contests.

## SUGGESTED ACTIVITIES

8. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Administer test.

I. Evaluate test.

J. Reteach if necessary

## REFERENCES USED IN DEVELOPING THIS UNIT

A. Bame, E. Allen and Paul Cummings. *Exploring Technology*. Worcester, MA: Davis Publications, 1980.

B. Henak, Richard M. *Exploring Construction*. South Holland, IL: Goodheart-Willcox Company, Inc., 1985.

C. Fales, James F., et al. *Technology Today and Tomorrow*. Mission Hills, CA: Glencoe/McGraw-Hill, 1988.

D. Feirer, John L. and John R. Lindbeck. *Production Technology*. Mission Hills, CA: Glencoe/McGraw-Hill, 1985.

E. Landers, Jack M. *Construction: Materials, Methods, Careers*. South Holland, IL: Goodheart-Willcox Company, Inc., 1983.

F. Lux, Donald G., et al. *World of Construction*. Mission Hills, CA: Glencoe/McGraw-Hill, 1988.

G. Williams, Charles F., et. al. *Technology for Tomorrow*. Cincinnati, OH: South-Western Publishing Company, 1985.

H. Wright, R. Thomas and Howard Bud Smith. *Understanding Technology*. South Holland, IL: Goodheart-Willcox Company, Inc., 1989.

## SUGGESTED SUPPLEMENTAL MATERIALS

Videotapes

A. *Introduction to Construction*, 15 min. Available from:

Agency for Instructional Technology
Box A
Bloomington, IN 47402
800-457-4509

## SUGGESTED ACTIVITIES

B. *Construction: Basic Principles.* Available from:

RMI Media Productions, Inc.
120 West 72th Street
Kansas City, MO 64114

C. *Construction Systems Technology: Defining Inputs.* Available from:

Bergwall Productions, Inc.
P.O. Box 238
Garden City, NY 11530-0238
800-645-3565

D. *Skill to Build America.* Available from:

Modern Talking Picture Service
5000 Park Street North
St. Petersburg, FL 33709
813-541-5763

E. *Careers in Construction.* 36 min. Available from:

Chronicle Guidance Publications, Inc.
Aurora St. Extension
P.O. Box 1190
Moravia, NY 13118-1190
800-OCC-PATH

# INTRODUCTION TO CONSTRUCTION
## UNIT C-1

## TEACHER SUPPLEMENT #1—USING AIT VIDEO C-1

### Introduction and Program Summary (15:31)

This program examines construction, its types, history, and relationship to other kinds of technology, society, and the environment. Defining construction as using people and resources to produce a structure on site, the program points out that homes are only one type of structure built. Students in classes are shown building construction models. CAD design processes, transportation and manufacturing of materials, and energy are all part of the construction process. In the 19th century, steel made vast construction projects possible, but these brought problems of overcrowding, traffic, and pollution.

The program introduces residential, civil, and commercial construction. Residential construction produces homes and apartments. An architect discusses the four stages of the design process and leads viewers on a tour of an apartment complex he has designed. The program demonstrates the application of the systems model to residential construction, in which the blueprint, materials, and energy are the input, the work of builders during the construction constitutes the process, the completed building is the output, and the response of residents and developers is the feedback. Civil construction is for the use of everyone. The controversial Denver airport, offering both the promise of economic growth and the possibility of noise, pollution, and higher fares is an example of civil construction. Commercial construction is exemplified by a new middle school, seen both under construction and newly finished. Its finishing is described in terms of the systems model. The program concludes raising the possibility of construction by robots on the moon or Mars. Should we construct a new way of life on other planets? Would you want to live there?

### Video Program Objectives

The video program will illustrate

- Types of construction (residential, commercial and civil) and the effects of present and future construction technology on society and the environment
- A systems model for the construction process (input, process, output, and a feedback loop)

### Before the Program

1. Tell your students this lesson introduces construction technology and its importance to us. Ask your students what the following have in common—bridges, houses, schools, dams, tunnels, malls, and interstate highways. *(These are all products of construction that are built on site and meet specific needs of mankind.)* Ask students to think of other examples of construction.
2. Tell students what they will be doing in the lab, and how the content of the video program will set the stage for the laboratory activity.

## TEACHER SUPPLEMENT #1

3. Tell students to note the following in the video program: the definition of construction; how construction technology is associated with the other technology system areas; historical developments in construction and their effects on people; three types of construction and examples of each; and the systems model as it relates to construction.

4. Tell students to listen for the following terms. (You might write them on the chalkboard.)

| | | |
|---|---|---|
| shelter | construction | airport |
| power plant | civil construction | bridges |
| architect | commercial construction | space construction |
| pyramids | residential construction | CAD |

**After the Program: Questions for Discussion and Review**

1. What is construction? *(using people and resources to produce a structure on site)*

2. What are some examples of construction shown in the video program? *(roads, airports, bridges, houses, power plants, dams, schools, concert stages, monuments, water treatment plants, and space stations)*

3. How are other technology system areas associated with construction? *(**communication**—structures are designed by architects using CAD/CAM systems: **transportation**—construction materials must be transported; **manufacturing**—tools and construction equipment is manufactured; **energy** runs machines and lights our cities)*

4. What are the three types of construction? Describe and provide examples of each. *(**residential**—buildings people live in, such as single family homes, apartments, condominiums; **civil**—structures built to serve the need of citizens, other than for shelter or residence, such as dams, bridges, railroads, pipelines, airports, etc; **commercial**—large structures built for business, industry, government, and education, such as factories, stadiums, stores, malls, and schools)*

5. The terms of the universal systems model are input, process, output, and feedback. Apply the systems model to the building of a new school. *(The **input** involves the use of materials, people, and energy. The construction **process** involves transforming these materials into a structure. The **output** is the finished school. The **feedback** is the response of the students and the teachers' reactions to the school, as well as its efficiency, durability, and so forth.)*

6. Describe some major changes in construction and how construction has affected people? *(Caves were first used for shelter; later structures, such as the Egyptian pyramids, were made of stone; in the 1800s steels was used for building large structures. In addition to many benefits, construction has caused overcrowding, traffic jams, and pollution.)*

## TEACHER SUPPLEMENT #1

7. What do architects do? *(Architects create designs and plans that show others how structures are to be constructed. They may also contract for the work to be done and supervise the construction of the projects to ensure their specific instructions are followed.)*

8. Should we construct an entirely new life on another planet? If we do, would you want to live there? *(student discussion)*

## INTRODUCTION TO CONSTRUCTION
## UNIT C-1

## TEACHER SUPPLEMENT #2—CROSSWORD PUZZLE

Name ______________________________ Date ____________________

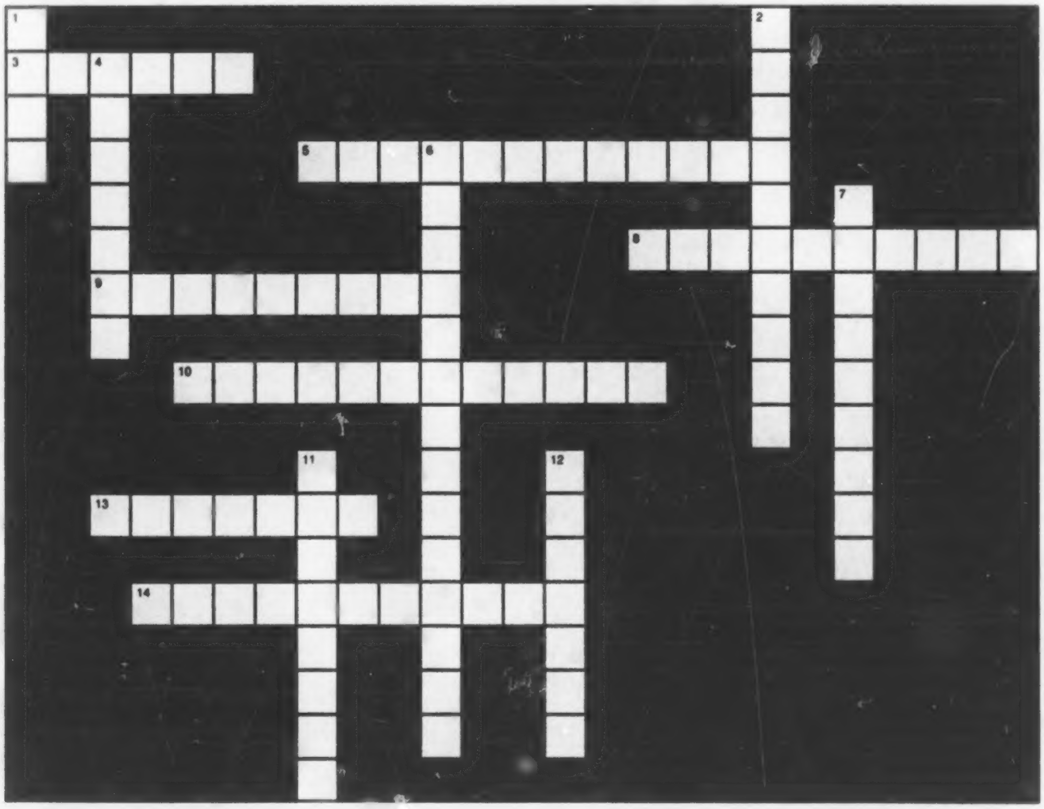
Directions: Use the clues below to solve the crossword puzzle.

ACROSS

3. Resources used in construction process
5. Using people and resources to produce a structure
8. Controls, plans, and organizes a project
9. A constructed product
10. Type of career that includes architects and contractors
13. Something that covers or protects from nature
14. Light construction

DOWN

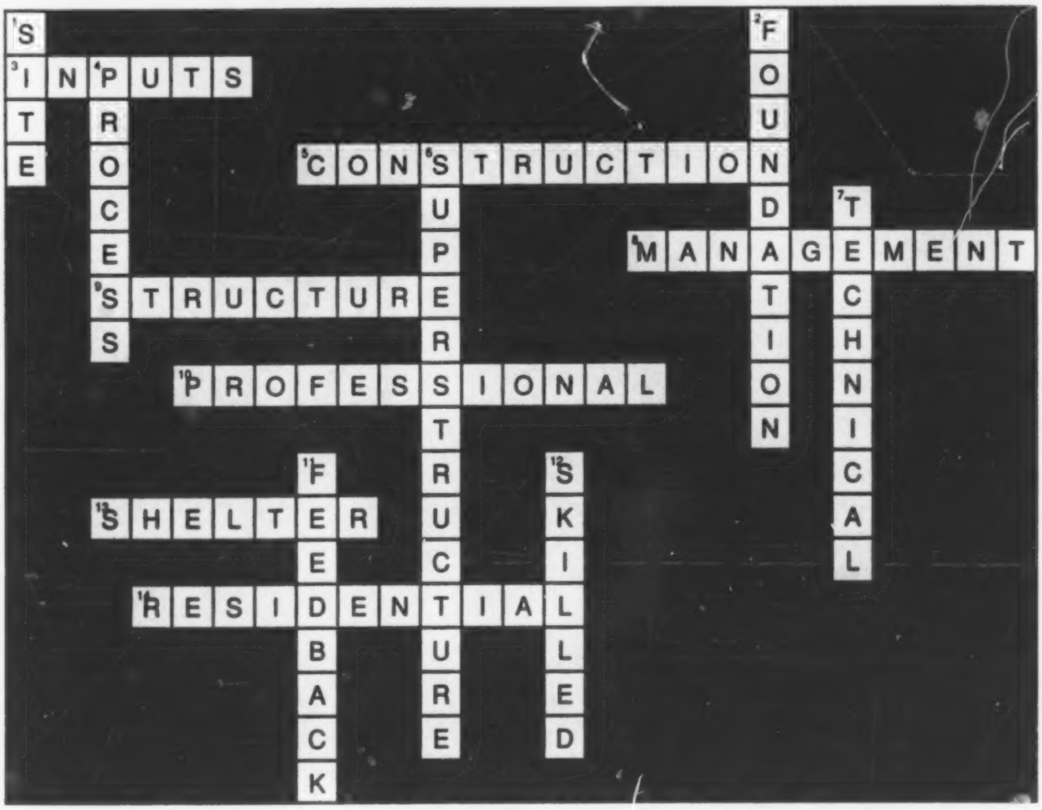
1. Location of an actual or planned structure
2. Structural support for a building
4. The action part of a construction project
6. All structural parts above the foundation
7. Type of career that includes drafters and surveyors
11. Evaluation of the system; includes client's and community's response
12. Type of career that includes carpenters, welders, and plumbers



12-C

## TEACHER SUPPLEMENT #2

## CROSSWORD PUZZLE ANSWER KEY



1 SITE
2 FOUNDATION
3 INPUTS
4 PROCESS
5 CONSTRUCTION
6 SUPERSTRUCTURE
7 TECHNICAL
8 MANAGEMENT
9 STRUCTURE
10 PROFESSIONAL
11 FEEDBACK
12 SKILLED
13 SHELTER
14 RESIDENTIAL

## INTRODUCTION TO CONSTRUCTION
## UNIT C-1

### TEACHER SUPPLEMENT #3—WORD SEARCH

Name ______________________________ Date ____________________

Directions: Find the words below hidden in the puzzle. Circle the words that you find.

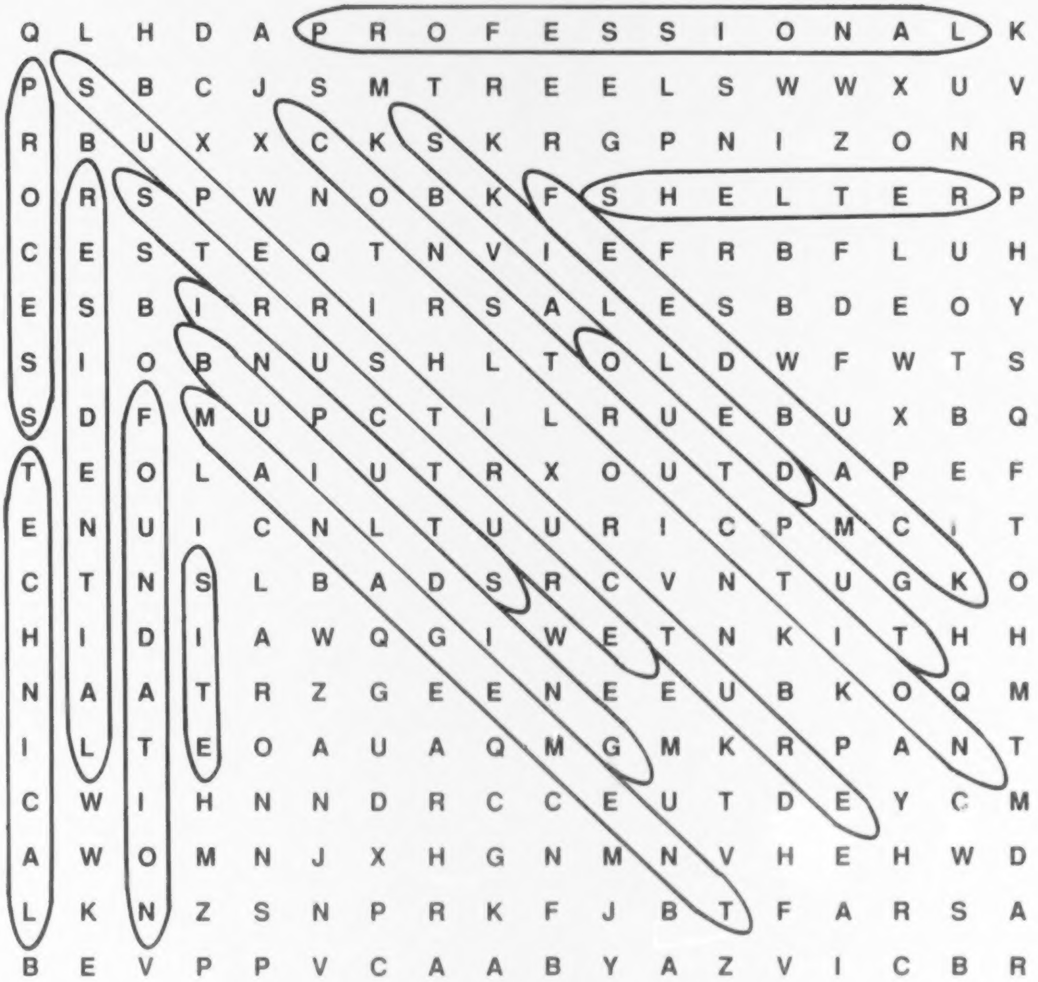
SUPERSTRUCTURE
FOUNDATION
BUILDING
SKILLED
CONSTRUCTION
MANAGEMENT
FEEDBACK
INPUTS
PROFESSIONAL
TECHNICAL
PROCESS
OUTPUT
RESIDENTIAL
STRUCTURE
SHELTER
SITE

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q | L | H | D | A | P | R | O | F | E | S | S | I | O | N | A | L | K |
| P | S | B | C | J | S | M | T | R | E | E | L | S | W | W | X | U | V |
| R | B | U | X | X | C | K | S | K | R | G | P | N | I | Z | O | N | R |
| O | R | S | P | W | N | O | B | K | F | S | H | E | L | T | E | R | P |
| C | E | S | T | E | Q | T | N | V | I | E | F | R | B | F | L | U | H |
| E | S | B | I | R | R | I | R | S | A | L | E | S | B | D | E | O | Y |
| S | I | O | B | N | U | S | H | L | T | O | L | D | W | F | W | T | S |
| S | D | F | M | U | P | C | T | I | L | R | U | E | B | U | X | B | Q |
| T | E | O | L | A | I | U | T | R | X | O | U | T | D | A | P | E | F |
| E | N | U | I | C | N | L | T | U | U | R | I | C | P | M | C | I | T |
| C | T | N | S | L | B | A | D | S | R | C | V | N | T | U | G | K | O |
| H | I | D | I | A | W | Q | G | I | W | E | T | N | K | I | T | H | H |
| N | A | A | T | R | Z | G | E | E | N | E | E | U | B | K | O | Q | M |
| I | L | T | E | O | A | U | A | Q | M | G | M | K | R | P | A | N | T |
| C | W | I | H | N | N | D | R | C | C | E | U | T | D | E | Y | C | M |
| A | W | O | M | N | J | X | H | G | N | M | N | V | H | E | H | W | D |
| L | K | N | Z | S | N | P | R | K | F | J | B | T | F | A | R | S | A |
| B | E | V | P | P | V | C | A | A | B | Y | A | Z | V | I | C | B | R |

*Duplication Permitted*

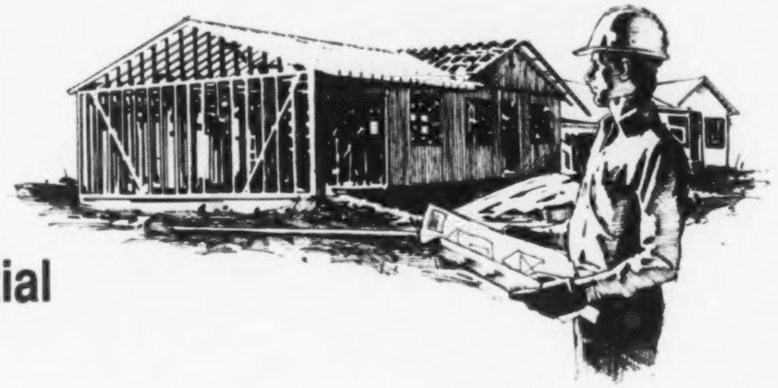
## TEACHER SUPPLEMENT #3

## WORD SEARCH ANSWER KEY

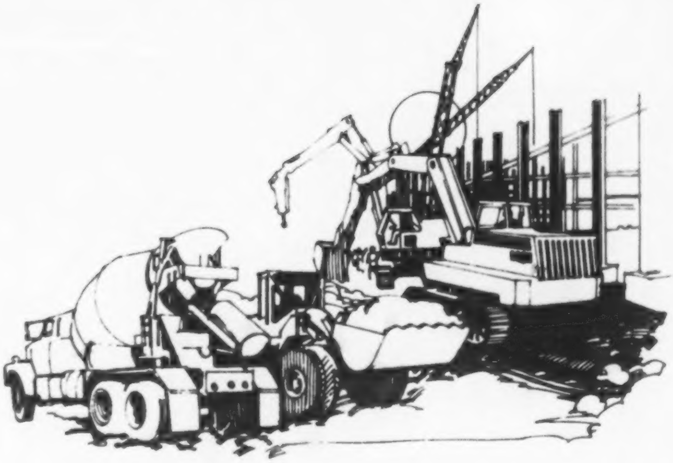


| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q | L | H | D | A | P | R | O | F | E | S | S | I | O | N | A | L | K |
| P | S | B | C | J | S | M | T | R | E | E | L | S | W | W | X | U | V |
| R | B | U | X | X | C | K | S | K | R | G | P | N | I | Z | O | N | R |
| O | R | S | P | W | N | O | B | K | F | S | H | E | L | T | E | R | P |
| C | E | S | T | E | Q | T | N | V | I | E | F | R | B | F | L | U | H |
| E | S | B | I | R | R | I | R | S | A | L | E | S | B | D | E | O | Y |
| S | I | O | B | N | U | S | H | L | T | O | L | D | W | F | W | T | S |
| S | D | F | M | U | P | C | T | I | L | R | U | E | B | U | X | B | Q |
| T | E | O | L | A | I | U | T | R | X | O | U | T | D | A | P | E | F |
| E | N | U | I | C | N | L | T | U | U | R | I | C | P | M | C | I | T |
| C | T | N | S | L | B | A | D | S | R | C | V | N | T | U | G | K | O |
| H | I | D | I | A | W | Q | G | I | W | E | T | N | K | I | T | H | H |
| N | A | A | T | R | Z | G | E | E | N | E | E | U | B | K | O | Q | M |
| I | L | T | E | O | A | U | A | Q | M | G | M | K | R | P | A | N | T |
| C | W | I | H | N | N | D | R | C | C | E | U | T | D | E | Y | C | M |
| A | W | O | M | N | J | X | H | G | N | M | N | V | H | E | H | W | D |
| L | K | N | Z | S | N | P | R | K | F | J | B | T | F | A | R | S | A |
| B | E | V | P | P | V | C | A | A | B | Y | A | Z | V | I | C | B | R |

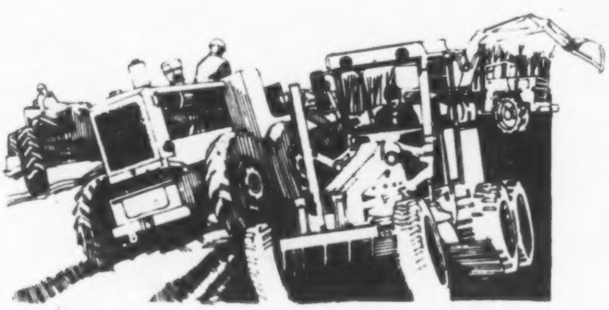
# Major Types of Construction



**Residential**



**Commercial**



**Civil**

# INTRODUCTION TO CONSTRUCTION
## UNIT C-1

## INFORMATION SHEET

I. **Terms and definitions**

A. Construction — Using people and resources to produce a structure on site

B. Construction technology — The effective use of materials, labor, equipment, methods, and management resources to produce a structure on site

C. Foundation — Structural support (substructure) for a building

D. Management — The part of a construction organization that controls, plans, and organizes a construction project

E. Shelter — Something that covers or protects from nature

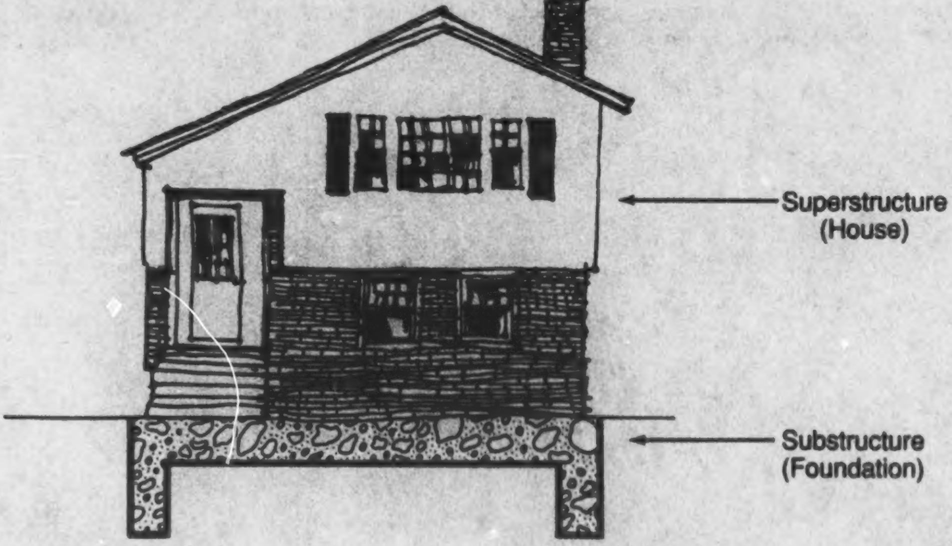
F. Site — Location of an actual or planned structure

G. Structure — Constructed product

H. Substructure — The underlying or supporting part of a structure

I. Superstructure — The part of a structure above the substructure

Example:

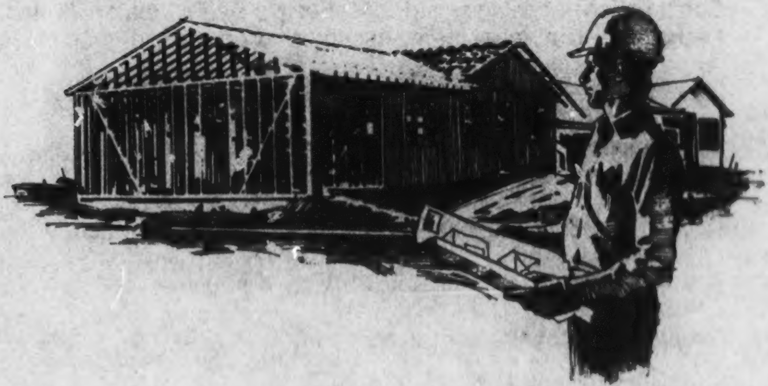


## INFORMATION SHEET

### II. Major types of construction

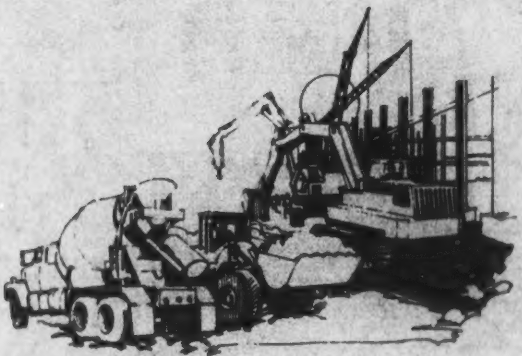
A. Residential or light construction — Concerned mainly with the building of homes, apartments, condominiums, and small commercial buildings

(NOTE: These are primarily of wood frame construction.)



B. Commercial construction — Primarily involved with the erection of commercial, industrial, educational, and institutional buildings

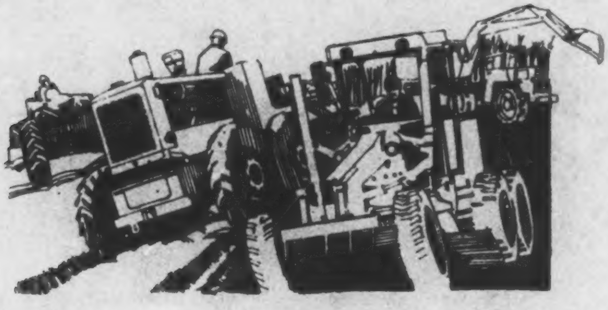
(NOTE: Materials used include steel, concrete, brick, glass, and ceramics. Interiors may be of wood construction.)



## INFORMATION SHEET

C. Civil and/or heavy construction — Includes the building of highways, railroads, pipelines, public utilities, water and sewer systems, dams, bridges, and electrical utilities

(NOTE: Many different materials are used such as gravel, earth, sand, steel, oil, wood, cement, glass, and plastic.)



### III. Purposes of construction

A. To provide housing

Examples: Single-family homes, apartments

B. To provide business/industry facilities

Examples: Factories, shopping centers, warehouses, restaurants, doctors' offices

C. For transportation

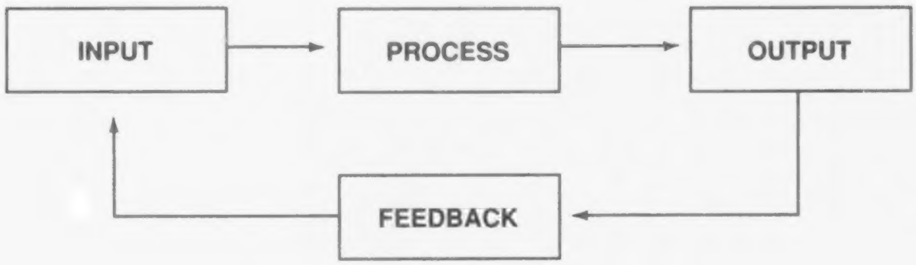
Examples: Highways, bridges, railroads, airports

D. To provide government facilities

Examples: City halls, military bases, public schools, state parks, capitols, sewage treatment plants

## INFORMATION SHEET

### IV. Parts of the construction system model



A. Inputs — People's skills and knowledge; materials such as wood, concrete, steel, and masonry products; energy sources; capital; tools and machines

B. Processes — Designing and drawing plans, site preparation, building foundations, framing, installing mechanical systems, finishing work

C. Outputs — Finished structures on the site

D. Feedback — Inspections, client's and community's responses, environmental impact, need for servicing

### V. Interrelationship between construction and the other technology systems

A. **Communication** — Communication techniques, devices, and systems are used throughout construction. In return, construction builds the structures needed by communication companies as well as the transmission lines for many types of communication.

B. **Manufacturing** — Manufacturing produces the equipment that is used by construction companies. In return, construction creates facilities for the manufacturing organizations to produce their products.

C. **Energy, power, and transportation** — Energy and power are needed to operate many construction tools and machines, and transportation is needed to move materials and workers to and from the site. In return, construction builds the power plants and transmission lines for most energy companies. Construction also builds various transportation systems.

## INFORMATION SHEET

### VI. Advantages and disadvantages of construction

A. Advantages

1. Provides safer, more comfortable homes
2. Provides better transportation
3. Provides utilities and sanitary systems
4. Promotes economic development of a community

B. Disadvantages

1. Can pollute the environment, especially through erosion of unprotected lands
2. Can ruin natural landscapes when too many structures are placed inappropriately
3. Can deplete natural resources when used excessively

### VII. Construction technology careers

A. Professional careers — Training usually requires a person being licensed in the state in which work is being done. A degree from an accredited college or university is required. Includes management careers.

Examples: Architects, engineers, contractors

B. Technical careers — Training requires 2-4 years of specialization. Includes careers in designing, planning, expediting, and distributing.

Examples: Drafters, surveyors, expeditors, inspectors

C. Skilled construction careers (trade occupations) — Training could include 3-5 years of apprenticeship (on-the-job training) or vocational and technical training at a vocational school or community college.

Examples: Carpenters, brick masons, welders, roofers, drywall installers, painters, floor layers, plumbers, pipefitters

## INTRODUCTION TO CONSTRUCTION
## UNIT C-1

### ASSIGNMENT SHEET #1 — IDENTIFY THE MAJOR TYPES OF CONSTRUCTION IN YOUR COMMUNITY

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Construction projects are correctly identified | ______ |
| Appropriate materials are listed | ______ |
| Assignment is neat and completed on time | ______ |

Directions: For the area where you live, list an example of the three types of construction. List the types of materials used in each.

A. Example of residential construction — ______________________________

Materials used ______________________________

B. Example of commercial construction — ______________________________

Materials used ______________________________

C. Example of civil construction — ______________________________

Materials used ______________________________

## INTRODUCTION TO CONSTRUCTION
## UNIT C-1

## ASSIGNMENT SHEET #2 — RESEARCH A CONSTRUCTION TECHNOLOGY CAREER

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Career selected is in construction field | ______ |
| Report is thorough and complete | ______ |
| Report is well written | ______ |
| Report is neat and completed on time | ______ |

Directions: Examples of careers in the construction field were discussed in Information Sheet. You may also be able to name other careers. Select a career you think you would enjoy and be successful. Research for more details.

Examples:
1. What is the exact training needed?
2. Where can you get that training?
3. What are the working conditions for that job?
4. What are the future possibilities of employment?
5. Why would you be good at that job?

Compile the results of your research and present it either in written or oral form as requested by your instructor.

A written research paper should include the following:

- Title page
- Introduction
- Review of literature (body)
- Conclusion
- Endnotes/Footnotes (if applicable)

# INTRODUCTION TO CONSTRUCTION
## UNIT C-1

## TEST

Name ______________________________ Score ____________________

1. Match the terms on the right with the correct definitions.

   ______a. Constructed product

   ______b. Something that covers and protects from nature

   ______c. Using people and resources to produce a structure on site

   ______d. The underlying or supporting part of a structure

   ______e. Location of an actual or planned structure

   1. Construction
   2. Construction technology
   3. Management
   4. Shelter
   5. Site
   6. Structure
   7. Substructure
   8. Superstructure

2. Distinguish among the major types of construction by placing an "X" next to the description of civil (heavy) construction.

   ______a. Includes the building of highways, railroads, pipelines, public utilities, water and sewer systems, dams, bridges, and electrical utilities

   ______b. Concerned mainly with the building of homes, apartments, condominiums, and small commercial buildings

   ______c. Primarily involved with the erection of commercial, industrial, educational, and institutional buildings

3. List two purposes of construction.

   a.______________________________________________________________

   b.______________________________________________________________

4. Categorize the following parts of the construction system model. Label each of the following as either inputs (I), processes (P), outputs (O), or feedback (F).

   ______a. Inspections

   ______b. Framing

   ______c. Installing mechanical systems

## TEST

______d. Materials such as wood and steel

______e. Client's response

______f. Tools and machines

______g. Finished structures on the site

______h. Site preparation

5. Discuss the interrelationship between construction and the other technology systems by answering the following questions.

   a. How does construction need manufacturing?

   ______________________________________________________________

   ______________________________________________________________

   b. How does manufacturing need construction?

   ______________________________________________________________

   ______________________________________________________________

6. Distinguish between the advantages and disadvantages of construction by placing an "A" next to the advantages and a "D" next to the disadvantages.

______a. Can pollute the environment

______b. Provides better transportation

______c. Can deplete natural resources

______d. Provides utilities and sanitary systems

______e. Provides safer, more comfortable homes

7. Match the careers listed on the right with the correct definitions.

______a. Training requires 3-5 years of apprenticeship or vocational school training

______b. Training requires a college degree and a license

______c. Training requires 2-4 years of specialization

1. Professional
2. Technical
3. Skilled
4. Unskilled

# TEST

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

8. Identify the major types of construction in your community. (Assignment Sheet #1)
9. Research a construction technology career. (Assignment Sheet #2)

## INTRODUCTION TO CONSTRUCTION
## UNIT C-1

### ANSWERS TO TEST

1. a. 6
   b. 4
   c. 1
   d. 7
   e. 5

2. a

3. Any two of the following:

   a. To provide housing
   b. To provide business/industry facilities
   c. For transportation
   d. To provide government facilities

4. a. F
   b. P
   c. P
   d. I
   e. F
   f. I
   g. O
   h. P

5. a. Answers will vary. Construction needs manufacturing for the equipment made by manufacturing organizations.

   b. Answers will vary. Manufacturing needs construction for the facilities made by construction companies.

6. a. D
   b. A
   c. D
   d. A
   e. A

7. a. 3
   b. 1
   c. 2

8.-.9 Evaluated to the satisfaction of the instructor

# DESIGNING AND PLANNING A STRUCTURE
## UNIT C-2

## UNIT OBJECTIVE

After completion of this unit, the student should be able to read a working drawing and design and plan a structure. Competencies will be demonstrated by completing the assignment sheets, lab activity sheet, and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to designing and planning a structure with the correct definitions.
2. Arrange in order the steps in designing and planning a structure.
3. Match the types of working drawings used in construction with the correct descriptions.
4. Match the main parts of a working drawing with the correct descriptions.
5. Identify the basic types of lines used on working drawings.
6. Match the materials commonly used in construction with the correct descriptions.
7. Apply formulas for measuring construction materials.
8. Identify the information on a bill of materials.
9. Calculate quantities of construction materials. (Assignment Sheet #1)
10. Read a working drawing and calculate construction quantities and cost. (Assignment Sheet #2)
11. Design a model truss bridge. (Assignment Sheet #3)
12. Design a garden/utility shed. (Assignment Sheet #4)
13. Design and construct a paper tower according to stated rules. (Lab Activity Sheet #1)

## DESIGNING AND PLANNING A STRUCTURE
## UNIT C-2

### SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher edition only and are designed to be used with the following objectives:

TM 1 — Main Parts of a Working Drawing — Objective 4
TM 2 — Use of Lines on a Drawing — Objective 5
TM 3-6 — Reasons for Using Construction Materials — Objective 6

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

G. Provide students with lab activity sheet.

H. Discuss and demonstrate the procedure outlined in the lab activity sheet.

I. Integrate the following activities throughout the teaching of this unit:

1. Use Teacher Supplement #1 to present AIT video C-2. This video was developed by the Agency for Instructional Technology (AIT) and a consortium of states to accompany this publication. Contact your state supervisor of technology education for copies, or contact AIT directly for more information:

   Agency for Instructional Technology (AIT)
   Box A, Bloomington, IN 47402
   800-457-4509 or 812-339-2203

2. Use Teacher Supplements #2 and #3 to help students understand this unit's terminology. Make copies (fronts only) for your students. The answers are on the backs of the supplements.

3. Show examples of working drawings and written specifications.

4. Tour a building supply company to see the many types of construction materials. Discuss the ways that common materials are sold (by size, weight, length, number, etc.)

5. Discuss new construction materials now available. Discuss the reasons for these new products.

## SUGGESTED ACTIVITIES

    6. Use TSA Competitive Events Guidelines for bridge building. (Assignment Sheet #3) Students may wish to enter regional and state contests through a TSA chapter.

    7. Alternate activities for Assignment Sheet #3 are model bridges made of spaghetti, paper, or plaster of paris. Compare their strengths to the wooden bridges.

    8. Alternate activities for Assignment Sheet #4 are a doghouse, playhouse, model wall section, doll house, scale model house, geodesic dome, or greenhouse.

    9. Working drawings for Assignment Sheet #4 may be drawn manually or with a CAD system, or you may prefer to buy a finished plan at the lumber yard or use a drawing produced earlier.

    10. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

J. Administer test.

K. Evaluate test.

L. Reteach if necessary.

## REFERENCES USED IN DEVELOPING THIS UNIT

A. Fales, James F., et. al. *Technology Today and Tomorrow.* Mission Hills, CA: Glencoe/McGraw-Hill, 1988.

B. Feirer, John L. and John R. Linbeck. *Production Technology.* Mission Hills, CA: Glencoe/McGraw-Hill, 1985.

C. Henak, Richard M. *Exploring Construction.* South Holland, IL: Goodheart-Willcox Company, Inc., 1985.

D. *Jackson's Mill Industrial Arts Curriculum Theory.* Charleston, West Virginia. West Virginia Department of Education.

E. Landers, Jack M. *Construction: Materials, Methods, Careers.* South Holland, IL: Goodheart-Willcox Company, Inc., 1983.

F. Lux, Donald G., et. al. *World of Construction.* Mission Hills, CA: Glencoe/McGraw-Hill, 1988.

G. Williams, Charles F. et. al. *Technology for Tomorrow.* Cincinnati, OH: South-Western Publishing Company, 1985.

H. Wright, R. Thomas, and Howard Bud Smith. *Understanding Technology.* South Holland, IL: Goodheart-Willcox Company, Inc., 1989.

## SUGGESTED ACTIVITIES

## SUGGESTED SUPPLEMENTAL MATERIALS

A. Videotapes

1. *The Other Bridge*. Color, 27 minutes, 1984. Explores the construction, design, and operation of the San Francisco-Oakland Bay Bridge. Includes an in-depth look at the world of engineering and design. Available from:

   Centre Productions, Inc.
   1800 30th St., #207
   Boulder, CO 80301
   800-824-1166

2. *Monument to a Dream.* Free loan. Story of the construction of the St. Louis Arch. Available from:

   Jefferson National Expansion Memorial
   11 North 4th Street
   St. Louis, MO 63102

3. *Highways of History*, 28 min. Available from:

   Modern Talking Pictures Service
   5000 Park Street North
   St. Petersburg, FL 33709
   813-541-5763

4. *Construction Systems Technology: Determining Resources*. Available from:

   Bergwall Productions, Inc.
   P.O. Box 238
   Garden City, NY 11530-0238
   800-645-3565

5. *Designing and Planning a Structure*, 13 min. Available from:

   Agency for Instructional Technology
   Box A
   Bloomington, IN 47402
   800-457-4509

B. Software (Apple, IBM, TRS-80, others)

1. *Blueprint Reading*
2. *Estimating*

   Available from:

   National Innovative Media Co.
   Route #2, Box 301B
   Calhoun, KY 42327
   800-962-6662

# DESIGNING AND PLANNING A STRUCTURE
## UNIT C-2

## TEACHER SUPPLEMENT #1—USING AIT VIDEO C-2

### Introduction and Program Summary (12:41)

This program introduces the design and planning process involved in construction. Site considerations are important. Teachers were consulted about important design considerations before construction of a new school. The program presents successful (Golden Gate Bridge) and unsuccessful (Tacoma Narrows Bridge) designs, and shows technology students designing and constructing model bridges in a competition to see whose is strongest. The students' bridge-building follows the systems model, in which their plans are the input, the process involves construction with wood pieces and glue, their finished bridges are the output, and the feedback comes when they see how well their bridges hold up in competition.

In another technology class, students engage in underwater construction under the direction of instructor Doug Craig. They are attempting to put together a geodesic dome to experience construction in a gravity-free environment. NSAS technicians perform similar construction experiments to learn about techniques for building an orbiting space station. Orville Simpson describes Victory City, his plan for a self-contained, low-energy, nonpolluting city of the future. In his plan, a single building over a mile long and over 100 stories high would house 260,000 people. Viewers are asked whether his ideas are utopian or a realistic possibility for the future.

### Video Program Objectives

The video program will illustrate

- primary considerations in the planning of structures (specifications, cost constraints, environmental impact)
- techniques and equipment used in designing structures (CAD systems)

### Before the Program

1. Tell your students this lesson is about the designing and planning of structures. Designing and planning is necessary for all areas of life as well as for technology. Coaches, students, and school officials plan strategies, plays, schedules, and activities.

2. Ask students what they would need to plan for if they were building a solar house or a school. Tell them that the video program they will see examines the planning of such structures and shows a city of the future. They will see consequences of good and bad planning.

3. Tell students what they will be doing in the lab, and how the content of the video program will set the stage for the laboratory activity.

## TEACHER SUPPLEMENT #1

4. Tell students to note the following in the video program: methods, tools, and devices used to plan and design structures: consequences of good and bad design; planning and design activities conducted in technology education laboratories; problems to be addressed by future planners; and the planning and design of structures for the future.

5. Tell students to listen for the following terms. (You might write them on the chalkboard.)

design
layout
geodesic dome
weightless construction
robotic arms
Victory City
planning
scale model
Golden Gate Bridge
energy efficiency
living quarters
CAD
site
space platform
orbiting space station
Tacoma Narrows Bridge

### After the Program: Questions for Discussion and Review

1. What things would you need to plan for constructing a solar house? *(A good site with windows facing south; energy efficiency)*

2. Describe how you might go about planning a new school. *(Student discussion—they may suggest questioning teachers and students about what is needed; visiting other schools; reading about the latest in school design; making drawings.)*

3. What are results of good planning and design? Bad planning and design? *(**Good**: structures do what they are supposed to, such as bridges that last and withstand natural forces; buildings are comfortable to live and work in, energy efficient, and pleasing in appearance; highways are safe and require minimal maintenance. **Bad:** unsafe, inefficient structures may break down, and they are uncomfortable and inconvenient. Encourage students to discuss examples of good and bad planning of construction projects in the community.)*

4. Explain how the following might be used in planning and designing for construction: CAD; aerial photographs; scale models. *(CAD or computer-aided design and drafting is used to generate drawings and analyze different designs; aerial photographs are used in planning buildings in cities and large sites; scale models are used to see how a structure looks in relation to its surroundings, as well as its general appearance.)*

5. Why were students assembling pieces of pipe in a swimming pool? *(They were participating in an underwater, weightless space construction simulation.)*

6. How will orbiting space stations be constructed? What is their purpose? *(The orbiting space station will be constructed of a series of modules manufactured on earth, transported by space shuttles into space, and assembled through the use of robotic arms and by astronauts. These stations will serve as living quarters for people researching conditions in space and new technologies.)*

7. What problems might be solved by a city like "Victory City"? *(pollution; the loss of species of wildlife and plants from urban sprawl and pollution; depletion of energy resources due to inefficient use)*

ETE-41-C

# DESIGNING AND PLANNING A STRUCTURE
## UNIT C-2

## TEACHER SUPPLEMENT #2—CROSSWORD PUZZLE

Name ______________________________ Date ________________

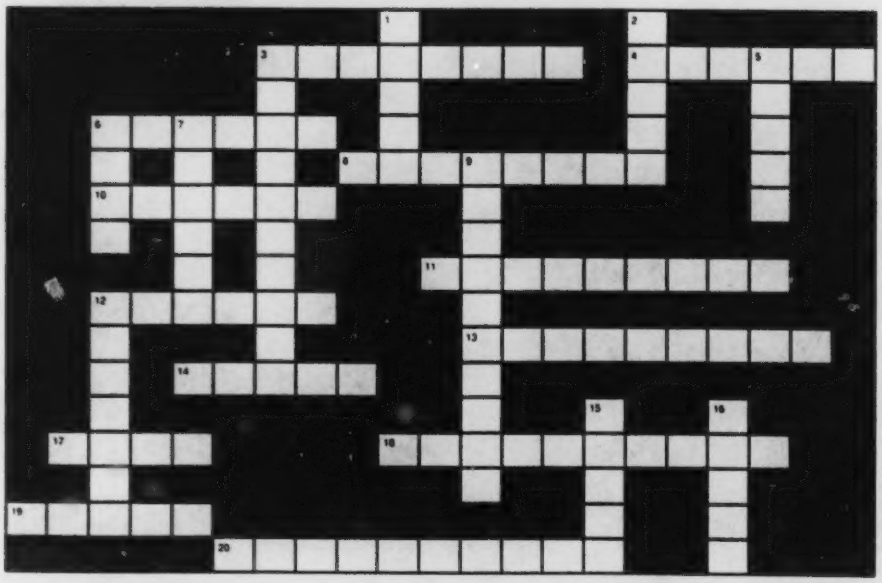
Directions: Use the clues below to solve the crossword puzzle.

ACROSS

3. Hard, strong construction material made of cement, aggregate, and water
4. Comes in the form of boards to be used for framing, siding, and flooring
6. Powderlike substance that acts as a binding ingredient in mortar
8. Drawings that show vertical sections of a structure such as a wall
10. To determine the form and position of a tract of land
11. Drawing that shows how the side of a structure will look
12. Permission to use the land
13. Used to measure quantities of lumber
15. Very strong metal used for structural frames
17. Part of a drawing that contains the views of an object
18. Drawings that show how an object will look to the eye
19. Government regulations that determine how a building is to be built
20. Conventional lines and figures showing sizes of objects and spaces on a drawing

DOWN

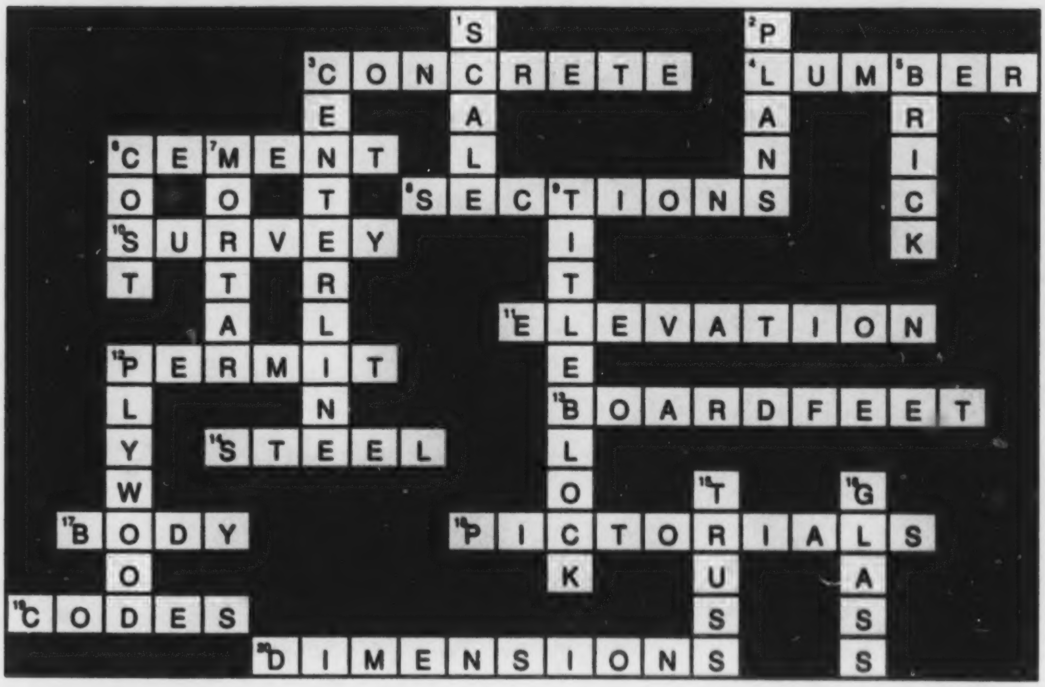
1. The ratio of reduction or enlargement used on a drawing
2. Drawings that show horizontal sections of a structure
3. Type of line used to show the centers of holes
5. Masonry material used for exterior and interior walls
6. Unit and total ______ may be on a bill of materials
7. Used to hold bricks together
9. Part of a drawing that contains basic information such as name and scale of drawing
12. Comes in 4′ x 8′ panels; may be used for subfloors
15. Framework of wood or metal members fastened together in the shape of a triangle
16. Construction material used to bring light into a building



*Duplication Permitted*

## TEACHER SUPPLEMENT #2

## CROSSWORD PUZZLE ANSWER KEY


1 SCALE
2 PLANS
3 CONCRETE
3 CENTERLINE
4 LUMBER
5 BRICK
6 CEMENT
6 COST
7 MORTAR
8 SECTIONS
9 TITLEBLOCK
10 SURVEY
11 ELEVATION
12 PERMIT
12 PLYWOOD
13 BOARDFEET
14 STEEL
15 TRUSS
16 GLASS
17 BODY
18 PICTORIALS
19 CODES
20 DIMENSIONS

## DESIGNING AND PLANNING A STRUCTURE
## UNIT C-2

### TEACHER SUPPLEMENT #3—WORD SEARCH

Name ______________________________ Date ____________________

Directions: Find the following words and circle them in the puzzle below.

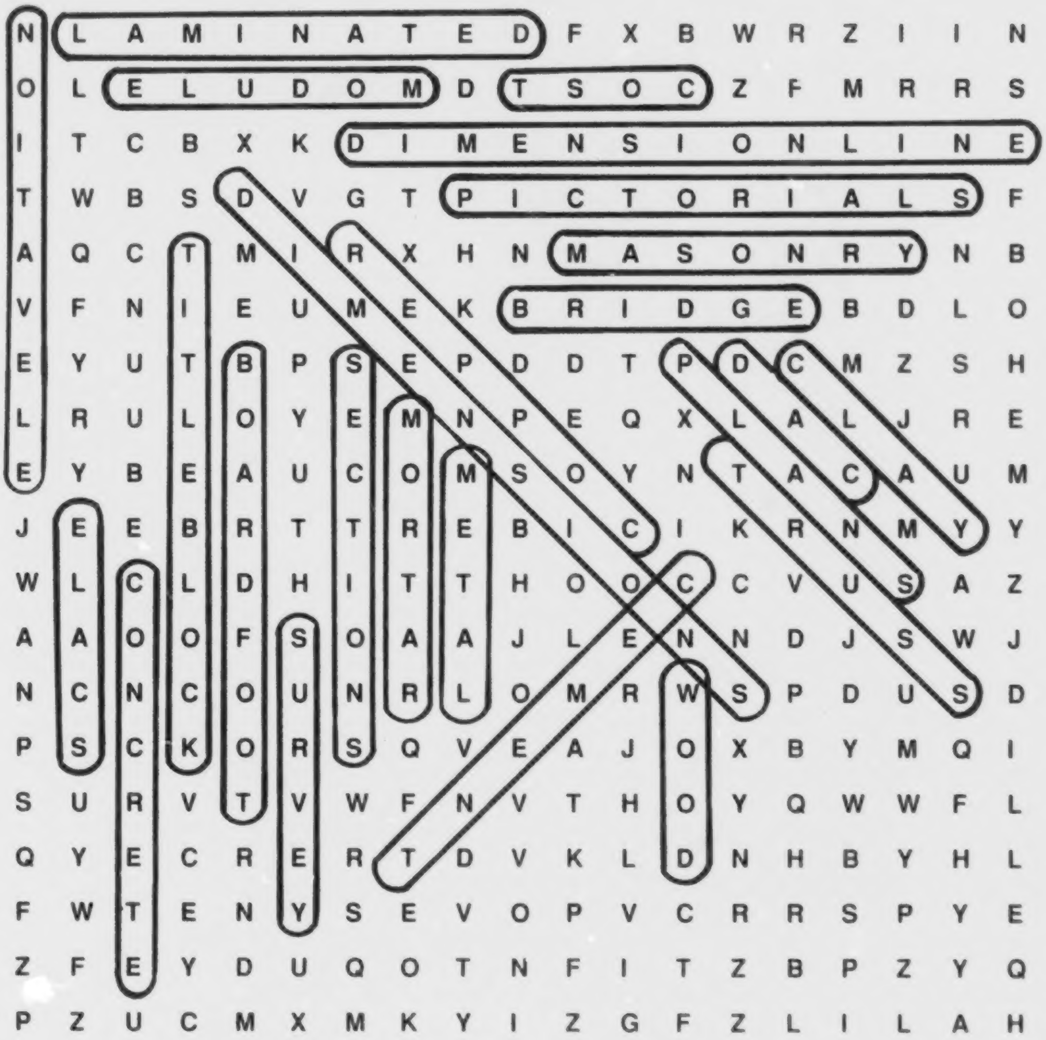
PLANS
SECTIONS
COPPER
CLAY
BOARDFOOT
MASONRY
MODULE
DIMENSIONS
COST
PICTORIALS
WOOD
CAD
BRIDGE
SCALE
TRUSS
CEMENT
CONCRETE
LAMINATED
ELEVATION
SURVEY
DIMENSIONLINE
MORTAR
METAL
TITLEBLOCK

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | L | A | M | I | N | A | T | E | D | F | X | B | W | R | Z | I | I | N |
| O | L | E | L | U | D | O | M | D | T | S | O | C | Z | F | M | R | R | S |
| I | T | C | B | X | K | D | I | M | E | N | S | I | O | N | L | I | N | E |
| T | W | B | S | D | V | G | T | P | I | C | T | O | R | I | A | L | S | F |
| A | Q | C | T | M | I | R | X | H | N | M | A | S | O | N | R | Y | N | B |
| V | F | N | I | E | U | M | E | K | B | R | I | D | G | E | B | D | L | O |
| E | Y | U | T | B | P | S | E | P | D | D | T | P | D | C | M | Z | S | H |
| L | R | U | L | O | Y | E | M | N | P | E | Q | X | L | A | L | J | R | E |
| E | Y | B | E | A | U | C | O | M | S | O | Y | N | T | A | C | A | U | M |
| J | E | E | B | R | T | T | R | E | B | I | C | I | K | R | N | M | Y | Y |
| W | L | C | L | D | H | I | T | T | H | O | O | C | C | V | U | S | A | Z |
| A | A | O | O | F | S | O | A | A | J | L | E | N | N | D | J | S | W | J |
| N | C | N | C | O | U | N | R | L | O | M | R | W | S | P | D | U | S | D |
| P | S | C | K | O | R | S | Q | V | E | A | J | O | X | B | Y | M | Q | I |
| S | U | R | V | T | V | W | F | N | V | T | H | O | Y | Q | W | W | F | L |
| Q | Y | E | C | R | E | R | T | D | V | K | L | D | N | H | B | Y | H | L |
| F | W | T | E | N | Y | S | E | V | O | P | V | C | R | R | S | P | Y | E |
| Z | F | E | Y | D | U | Q | O | T | N | F | I | T | Z | B | P | Z | Y | Q |
| P | Z | U | C | M | X | M | K | Y | I | Z | G | F | Z | L | I | L | A | H |

*Duplication Permitted*

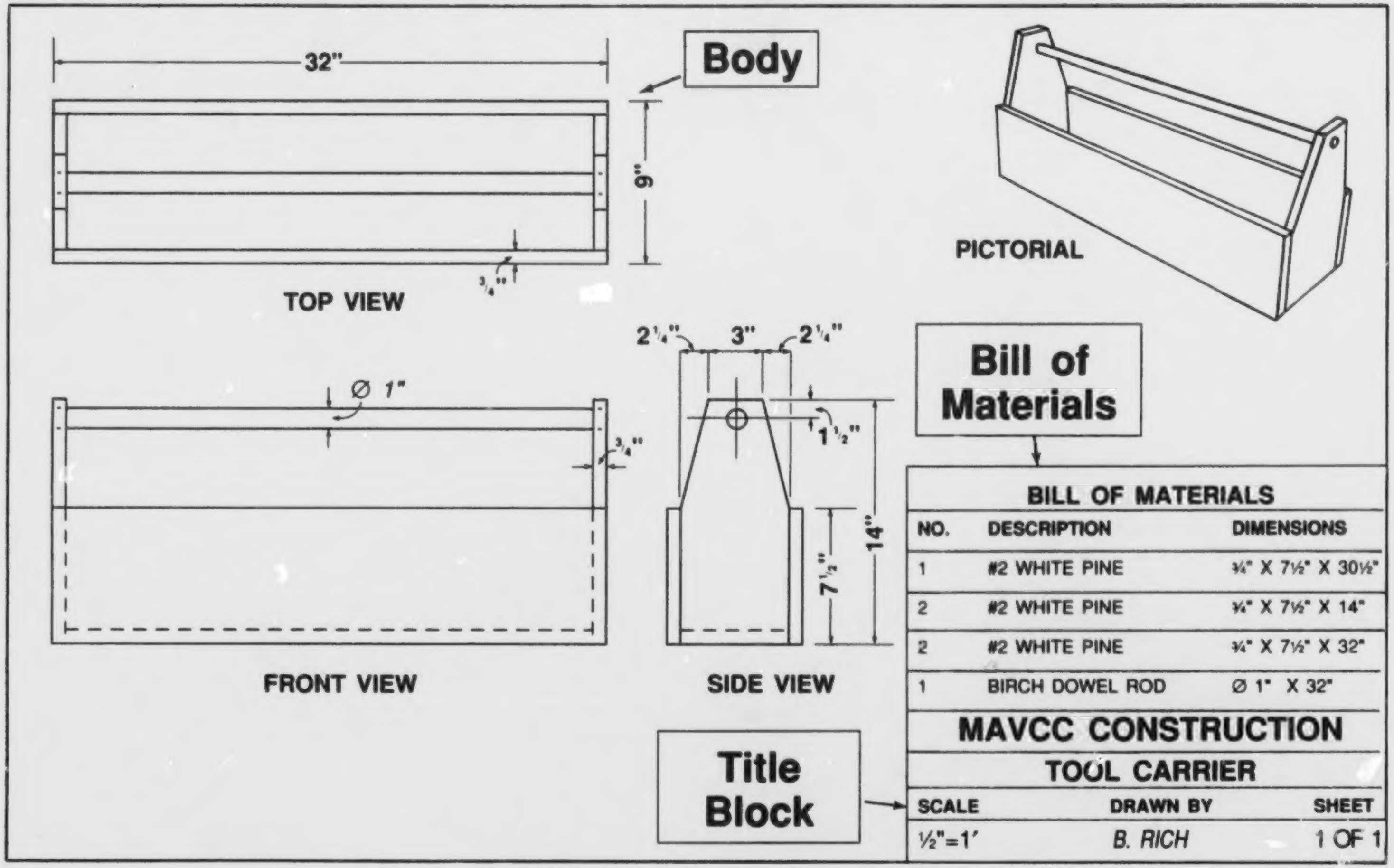
## TEACHER SUPPLEMENT #3

### WORD SEARCH ANSWER KEY



N L A M I N A T E D F X B W R Z I I N
O L E L U D O M D T S O C Z F M R R S
I T C B X K D I M E N S I O N L I N E
T W B S D V G T P I C T O R I A L S F
A Q C T M I R X H N M A S O N R Y N B
V F N I E U M E K B R I D G E B D L O
E Y U T B P S E P D D T P D C M Z S H
L R U L O Y E M N P E Q X L A L J R E
E Y B E A U C O M S O Y N T A C A U M
J E E B R T T R E B I C I K R N M Y Y
W L C L D H I T T H O O C C V U S A Z
A A O O F S O A A J L E N N D J S W J
N C N C O U N R L O M R W S P D U S D
P S C K O R S Q V E A J O X B Y M Q I
S U R V T V W F N V T H O Y Q W W F L
Q Y E C R E R T D V K L D N H B Y H L
F W T E N Y S E V O P V C R R S P Y E
Z F E Y D U Q O T N F I T Z B P Z Y Q
P Z U C M X M K Y I Z G F Z L I L A H

# Main Parts of a Working Drawing


32"
9"
3/4"
TOP VIEW
PICTORIAL
2 1/4"
3"
2 1/4"
Ø 1"
3/4"
1 1/2"
14"
7 1/2"
FRONT VIEW
SIDE VIEW

**Body**

**Bill of Materials**

**Title Block**

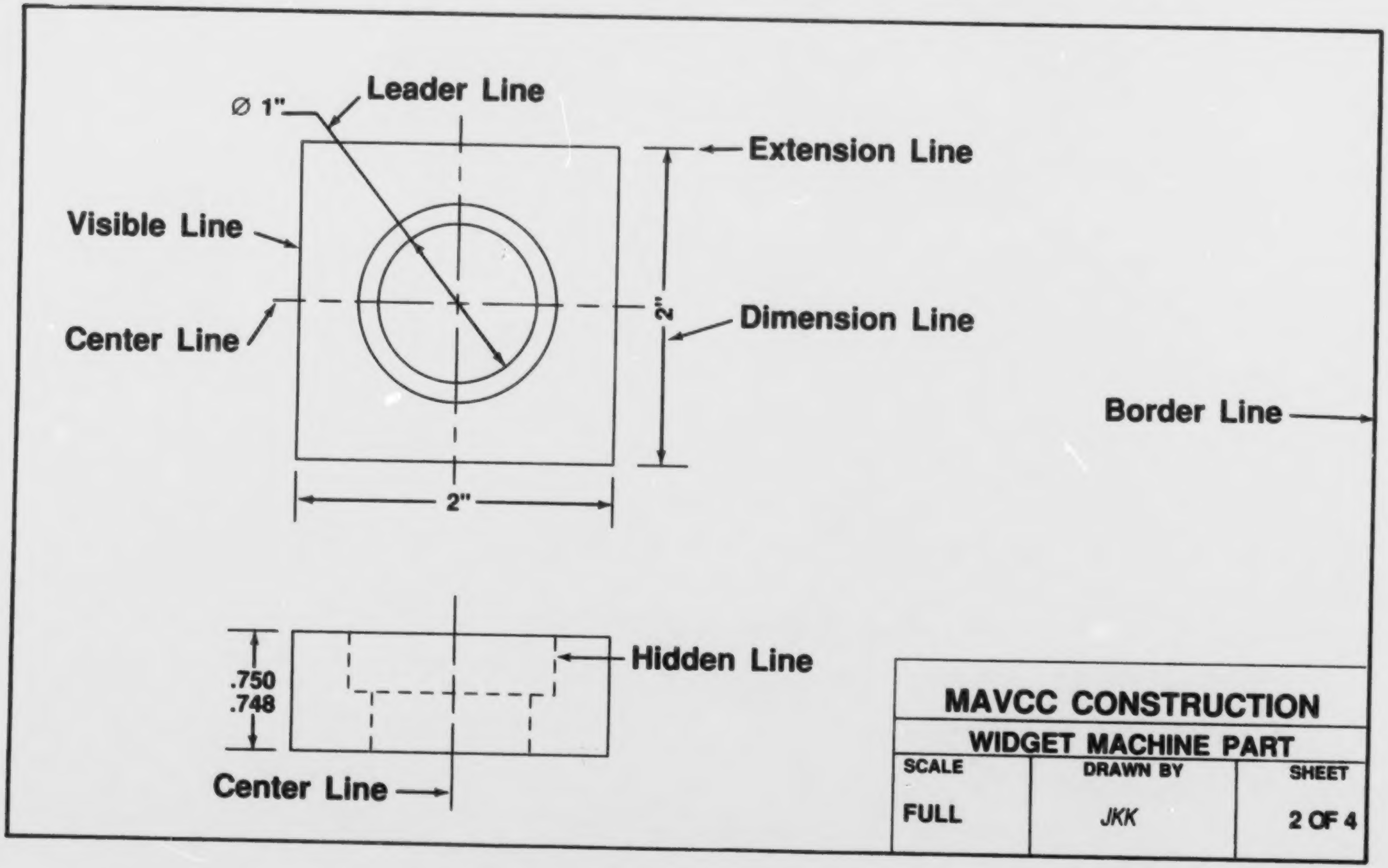
| BILL OF MATERIALS | | |
|---|---|---|
| **NO.** | **DESCRIPTION** | **DIMENSIONS** |
| 1 | #2 WHITE PINE | 3/4" X 7½" X 30½" |
| 2 | #2 WHITE PINE | 3/4" X 7½" X 14" |
| 2 | #2 WHITE PINE | 3/4" X 7½" X 32" |
| 1 | BIRCH DOWEL ROD | Ø 1" X 32" |

**MAVCC CONSTRUCTION**

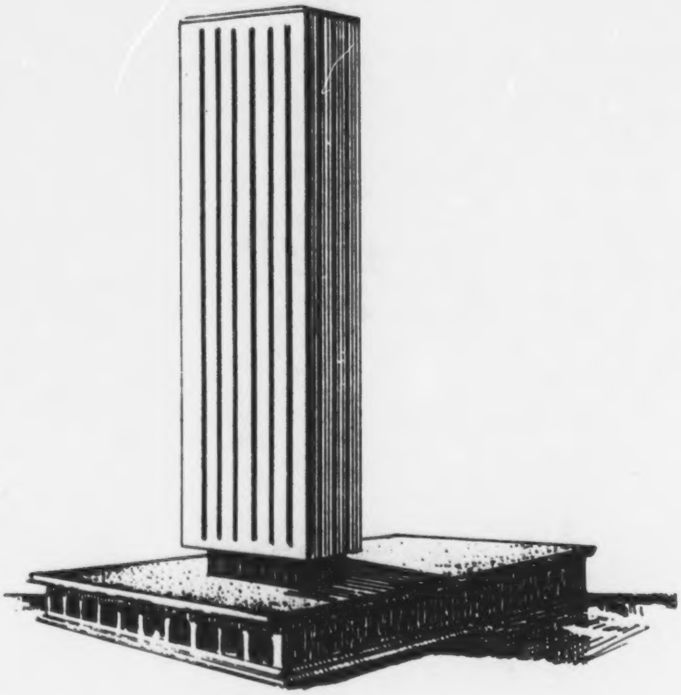
**TOOL CARRIER**

| SCALE | DRAWN BY | SHEET |
|---|---|---|
| ½"=1' | *B. RICH* | 1 OF 1 |

# Use of Lines on a Drawing

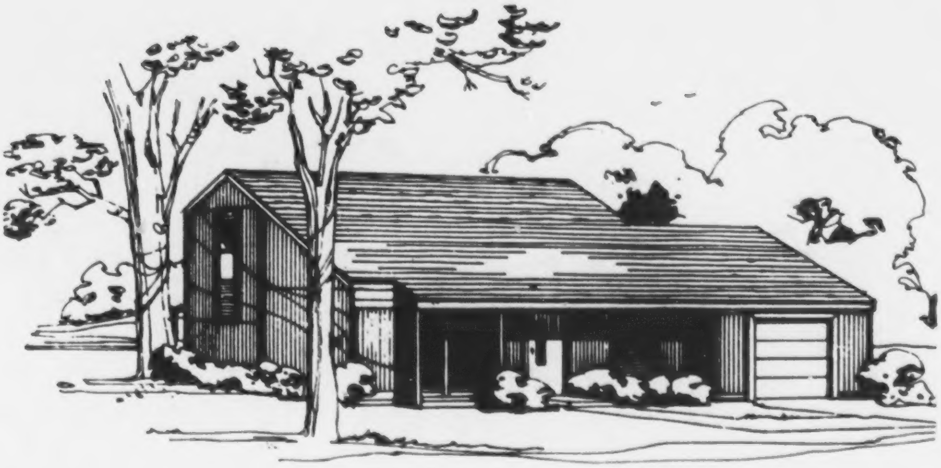

Ø 1"
Leader Line
Extension Line
Visible Line
Center Line
2"
Dimension Line
Border Line
2"
.750
.748
Hidden Line
Center Line
MAVCC CONSTRUCTION
WIDGET MACHINE PART
SCALE
FULL
DRAWN BY
JKK
SHEET
2 OF 4

# Reasons for Using Concrete



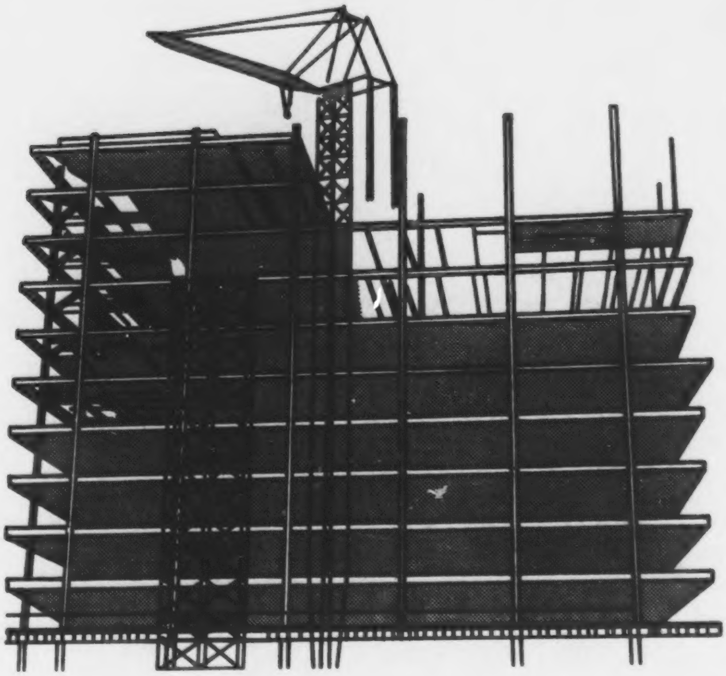
1. Adaptable and serviceable in a variety of situations
2. Permanent when properly made
3. Sanitary and easily cleaned
4. More fireproof than other building materials
5. Economical in installation and in maintenance
6. Easy to use

# Reasons for Using Wood



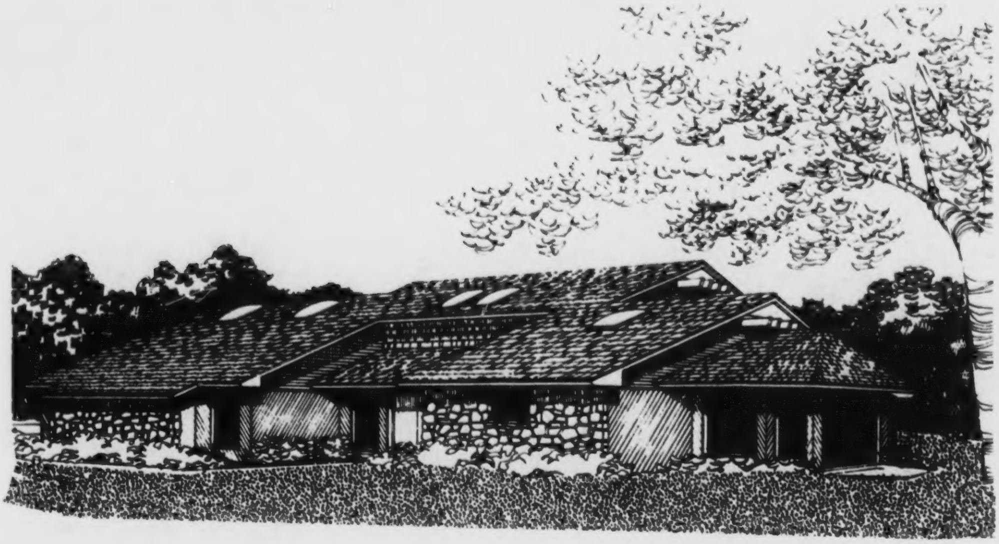
1. Strong and durable
2. Adaptable
3. Easy to use
4. Readily available and renewable
5. Looks warm and natural

# Reasons for Using Metal



1. Very long lasting with low-maintenance needs
2. Fireproof
3. Steel is very strong
4. Readily available

# Reasons for Using Masonry Materials



1. Long lasting with low maintenance needs
2. Strong
3. Fireproof
4. Natural looking
5. Provide architectural interest

# DESIGNING AND PLANNING A STRUCTURE
## UNIT C-2

## INFORMATION SHEET

I. **Terms and definitions**

A. Blueprint — Reproduction of an architect's or engineer's drawing

(NOTE: A true blueprint has white lines on a blue background; however, most of today's reproductions produce a blue, black, or sepia-colored line on a white background and are called bluelines, blacklines, or sepias.)

B. Building codes — Government regulations that determine how a building is to be built

C. Building permit — Permission to use the land

D. Cement — Powderlike substance that when mixed with water is used as a binding ingredient of mortar and concrete

E. Contract — Legal agreement between two or more persons or parties for the supply of specified goods or services at a fixed price

(NOTE: A construction contract consists of the agreement, specifications, and drawings.)

F. Contractor — Individual who manages all or part of a construction project

G. Dimensions — Conventional lines and figures showing sizes of objects and spaces on a drawing

H. Masonry — Use of stonework and brickwork for construction

I. Mortar — Mixture of lime, cement, sand, and water used to hold blocks or bricks together

J. Scale — Ratio of reduction or enlargement used on a drawing

K. Specifications (specs) — Written instructions describing the basic requirements for constructing a project

L. Survey — To determine the form and position of a tract of land

M. Truss — Framework of wood or metal members fastened together in the shape of a triangle

N. Working drawing — Drawing giving dimensions and other needed information for construction

O. Zoning ordinances — Laws set by governments (usually city) to control land use

## INFORMATION SHEET

### II. Steps in designing and planning a structure

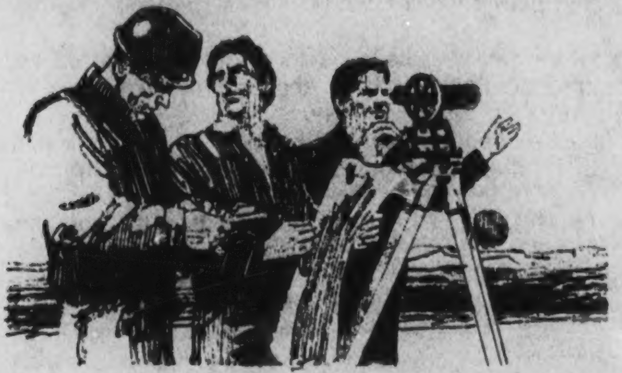
A. Owner meets with designer (architect or engineer) to begin the design process.

1. Designer discusses needs and wants of owner.

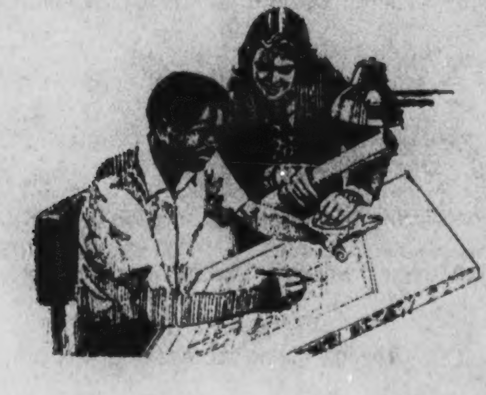
2. Designer makes preliminary sketches and changes them as needed by owner.

B. Designer checks local building codes and zoning ordinances to make sure project can be built as the owner wants it in the selected site.

C. Surveyors and/or engineers study the site to determine natural and man-made features on the land as well as soil tests to see if the soil and sub-soil can support the planned structure.



D. Designer makes working drawings and specifications. Owner approves them.



## INFORMATION SHEET

E. Building contractor is selected. (May or may not include bidding process)

   1. For larger projects several contractors estimate costs and submit bids on the project. The lowest bid meeting the specifications is selected.

   2. For smaller projects the owner or architect may act as the general contractor.

F. Contractor obtains building permit.

G. Contractor orders materials and equipment and hires workers.

(NOTE: Site preparation and building can now begin. These will be covered in the next unit.)

### III. Types of working drawings used in construction

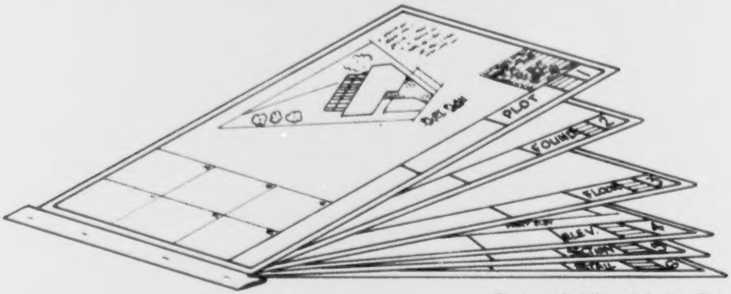
A. Plans — Drawings that show horizontal imaginary cuts of a structure; includes plot, floor, foundation, roof, electrical, mechanical systems, and landscape plans (all may not be needed)

B. Elevations — Drawings that show how the sides of structure will look; include north, south, east, and west sides (all may not be needed)

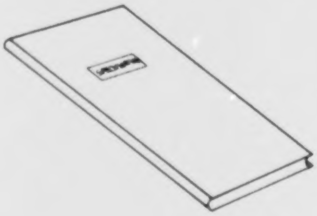
C. Sections — Drawings that show vertical imaginary cuts of a structure; includes wall, fireplace, roof, and foundation sections (all may not be needed)

D. Pictorials — Drawings that represent how an object will look to the eye

(NOTE: The working drawings and the written specifications will become part of the contract with the contractor.)



**Set of Working Drawings**



**Specifications**

## INFORMATION SHEET

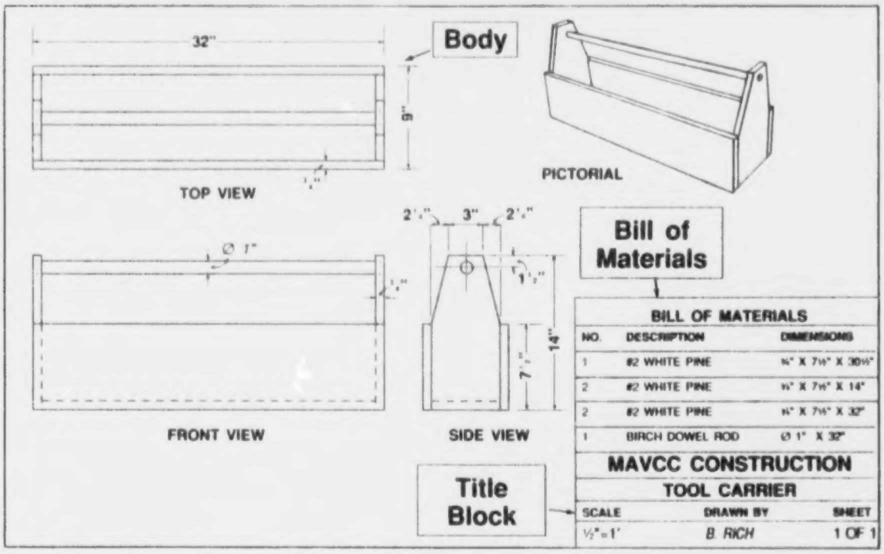
### IV. Main parts of a working drawing

A. Body — Contains different views of the object to be built including dimensions, symbols, notes, and other information

B. Bill of materials — Provides itemized list of number, description, and dimensions of each piece of material needed to construct an object

(NOTE: The bill of materials is usually located in the lower right-hand corner above the title block. You will need to consult this list when you order the materials for your project.)

C. Title block — Contains basic information such as name and scale of drawing


32"
Body
9"
¾"
TOP VIEW
PICTORIAL
Ø 1"
¾"
FRONT VIEW
2¼"
3"
2¼"
1½"
14"
7¼"
SIDE VIEW
Bill of Materials
Title Block

BILL OF MATERIALS

| NO. | DESCRIPTION | DIMENSIONS |
|---|---|---|
| 1 | #2 WHITE PINE | ¾" X 7¼" X 30½" |
| 2 | #2 WHITE PINE | ¾" X 7¼" X 14" |
| 2 | #2 WHITE PINE | ¾" X 7¼" X 32" |
| 1 | BIRCH DOWEL ROD | Ø 1" X 32" |

MAVCC CONSTRUCTION

TOOL CARRIER

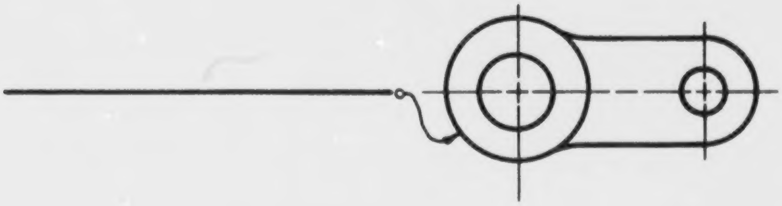
| SCALE | DRAWN BY | SHEET |
|---|---|---|
| ½"=1' | B. RICH | 1 OF 1 |

## INFORMATION SHEET

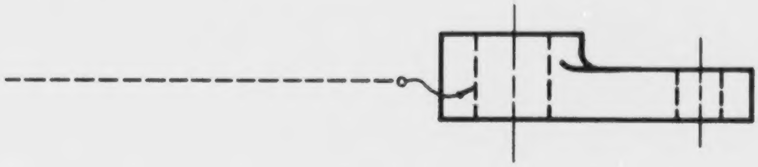
V. **Basic types of lines used on working drawings**

A. Visible lines — Used to show all visible edges or contours of an object

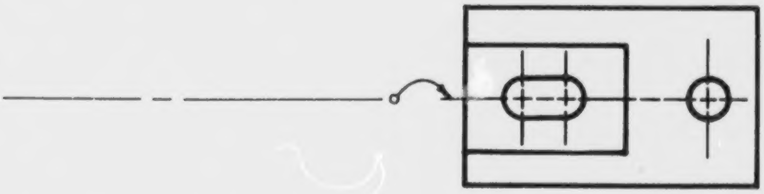
(NOTE: Visible lines are sometimes called object lines.)



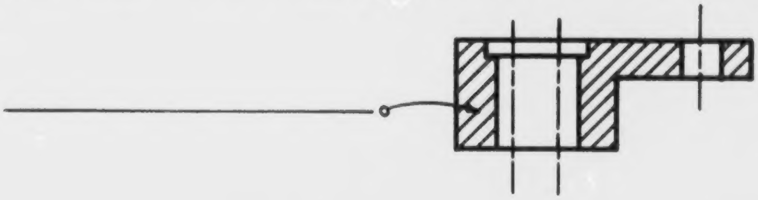
B. Hidden lines — Used to show surfaces or features on an object that are not visible



C. Center lines — Used to show the centers of holes or round shapes



D. Section lines — Used to show a surface that has been cut in a section view

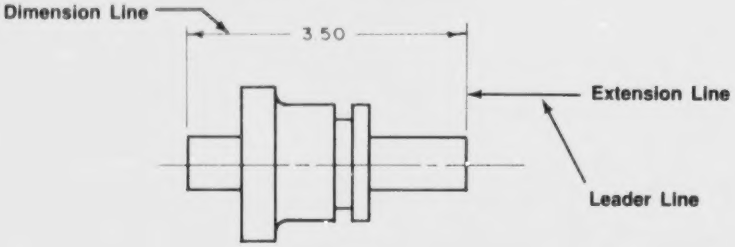


## INFORMATION SHEET

E. Extension lines — Used for placing dimensions on drawings; these extend (but do not touch) from the lengths and widths of objects

F. Dimension lines — Used to show the size (dimensions) of an object; spans from one extension line to the next, has arrowheads at both ends, and is broken in the middle for the measurement number (dimension)

G. Leader lines — Used to direct descriptive information, notes, or special dimensions to features on the drawing



H. Border lines — Used to define the outer edges or margins on the drafting media; the drawing and all other information is inside this border

---

### VI. Materials commonly used in construction

A. Concrete — Hard, strong building material made by mixing cement and an aggregate (such as sand and gravel) with sufficient water to cause the cement to set and bind the entire mass

B. Wood

1. Lumber — Comes in the form of boards to be used for framing, siding, flooring, trim, and concrete forms
2. Plywood — Comes in 4′ x 8′ panels and is used for support and to decorate structures as sheathing, roof decks, and subfloors
3. Laminated timbers — Made from lumber that is glued together and used for arches, poles, and beams
4. Engineered panels — Modified wood products bonded with glue and formed into boards

   Examples: Waferboard, particle board, oriented strand board
5. Pressure-treated wood — Specially-treated wood which resists decay, mold, and insects

## INFORMATION SHEET

C. Metal

1. Steel — Very strong metai (iron alloy); primarily used for structural frames

2. Aluminum — Light metal that has good electrical and thermal conductivity, high reflectivity, and resistance to oxidation; commonly used for exterior siding

3. Copper — A reddish metal that is easily worked and joined and is an excellent electrical and thermal conductor; commonly used for wiring, plumbing pipes, and roofing

D. Masonry materials — Clay and mineral products primarily used for exterior and interior walls; includes bricks, stones, tiles, and concrete blocks

(NOTE: Masonry units are commonly joined with mortar.)

E. Others

1. Glass — Used to bring light into the building; may have multiple panes and may be tinted or treated to conserve energy

2. Insulation — Used to reduce heat transfer and noise; commonly made of fiberglass, mica, wood, cork, or plastic products

3. Plastic — Used to cover electrical wires, for piping, trim, insulating foam, and for many new products

**VII. Formulas for measuring construction materials**

A. Concrete — Measure volume using the following formula:

$$\text{Volume in cubic yards} = \frac{\text{Length in feet} \times \text{Width in feet} \times \text{Thickness in feet}}{\text{27 cubic feet}}$$

Example: $$\frac{10\text{ ft.} \times 3\text{ ft.} \times \frac{1}{3}\text{ ft.}}{27\text{ ft}^3} = \frac{10\text{ ft.}^3}{27\text{ ft.}^3} = \frac{1}{3}\text{ cu. yd.}$$

B. Lumber — Measure quantity in board feet using the following formula:

$$\text{Board feet} = \frac{\text{Number of pieces} \times \text{Length in feet} \times \text{Width in inches} \times \text{Thickness in inches}}{12}$$

Example: $$\frac{10\text{ pieces} \times 10' \times 6'' \times 4''}{12} = \frac{2400}{12} = 200\text{ board feet}$$

(NOTE: If width dimension is in feet, you will not need to divide by 12.)

## INFORMATION SHEET

### VIII. Information on a bill of materials

(NOTE: This is also referred to as a parts list.)

A. Number of pieces needed

B. Description of item

C. Dimensions of item

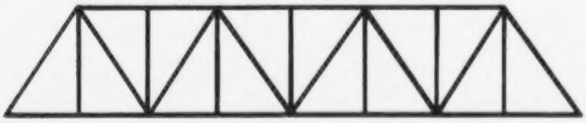
(NOTE: A bill of materials from the lumber yard or building supply company will also include unit and total cost for each item.)

**BILL OF MATERIALS**

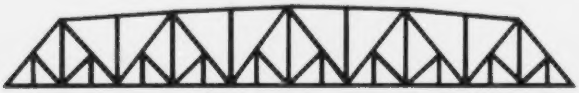
| NO. OF PIECES | DESCRIPTION | DIMENSIONS |
|---|---|---|
| *1* | *#2 WHITE PINE* | *¾" X 7½" X 30½"* |
| *2* | *#2 WHITE PINE* | *¾" X 7½" X 14"* |
| *2* | *#2 WHITE PINE* | *¾" X 7½" X 32"* |
| *1* | *BIRCH DOWEL ROD* | *∅ 1" X 32"* |

## DESIGNING AND PLANNING A STRUCTURE
## UNIT C-2

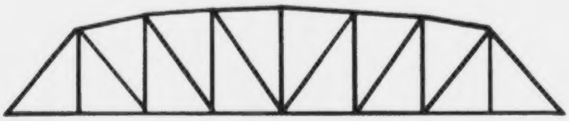
### STUDENT HANDOUT #1 — SIMPLE TRUSSES FOR BRIDGES



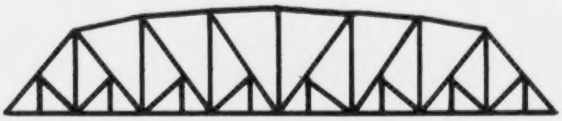
Warren Truss



Subdivided Warren Truss



Pratt Truss



Subdivided Pratt Truss

## DESIGNING AND PLANNING A STRUCTURE
## UNIT C-2

## ASSIGNMENT SHEET #1 — CALCULATE QUANTITIES OF CONSTRUCTION MATERIALS

Name ______________________________ Overall Rating ______________

| EVALUATION CRITERIA | RATING |
|---|---|
| Used correct formulas | ______ |
| Calculated quantities correctly | ______ |
| Assignment is neat and completed on time | ______ |

Directions: Solve the following problems by using the formulas discussed in the information sheet to calculate quantities of construction materials. Show your work.

A. In order to cover an entire floor in a utility shed, you will have to purchase 24 pine boards that measure 1 foot wide x 12 feet long x 1" thick.

What is the total board feet for this purchase? ______________________

B. A concrete patio measures 1′ thick by 8′ wide by 17′ long.

How many cubic yards of concrete should you order? ______________________

C. In order to cover a wall in your garage, you will have to purchase 6 pine boards that measure 6 inches wide x 12 feet long x 1" thick.

What is the total board feet for this purchase? ______________________

## ASSIGNMENT SHEET #1

D. A concrete porch measures 6" thick by 6′ wide by 10′ long.

How many cubic yards of concrete are needed? ______________________________

E. For your construction project you need twelve pieces of lumber 1" x 1′ x 12′. How many total board feet is this? ______________________________

F. A concrete sidewalk measures 4" thick by 3′ wide by 54′ long. How many cubic yards of concrete do you need? ______________________________

## DESIGNING AND PLANNING A STRUCTURE
## UNIT C-2

## ASSIGNMENT SHEET #2—READ A WORKING DRAWING AND CALCULATE CONSTRUCTION QUANTITIES AND COST

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Questions are answered correctly | ______ |
| Assignment is neat and completed on time | ______ |

Directions: Answer the following questions about the given working drawing (located on the next page).

A. Identify the parts of the working drawing noted with letter callouts.

1. Item a ______________________________
2. Item b ______________________________
3. Item c ______________________________

B. Identify the types of lines noted with letter callouts.

1. Item d ______________________________
2. Item e ______________________________
3. Item f ______________________________

C. List the four rooms shown.

1. ____________________
2. ____________________
3. ____________________
4. ____________________

D. How many doors are shown?

1. Total ____________________
2. Exterior ____________________
3. Interior ____________________

## ASSIGNMENT SHEET #2

E. What is the overall measurement of the building? ____________________

F. 2x4 studs are normally spaced 16" apart. However, to estimate the number of 2x4 studs for the walls, it is customary to allow one stud for every one foot of wall. Round answer up for ½ foot or more. The studs cost $.75 each.

1. How many studs will be needed for the four walls of the manager's office? ____________________ Cost? $ ____________________

2. How many studs will be needed for the exterior walls of the building? ____________________ Cost? $ ____________________

3. How many studs will be needed for the file room's four walls? ____________________ Cost? $ ____________________

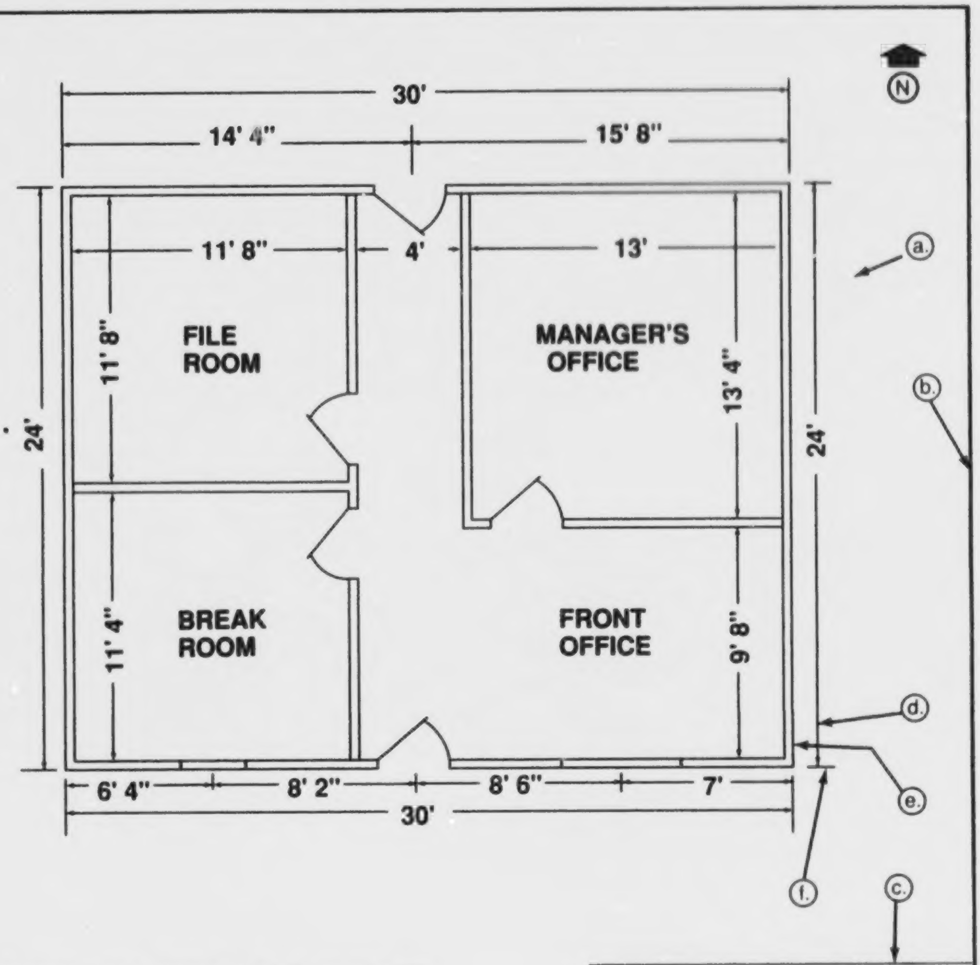
G. What is the measurement of the break room? ____________________

H. What is the thickness of the walls in the building? ____________________

I. How many windows are on the south wall? ____________________
West wall? ____________________

J. What type of working drawing is this? ____________________

## ASSIGNMENT SHEET #2


N
30'
14' 4"
15' 8"
11' 8"
4'
13'
a.
FILE ROOM
MANAGER'S OFFICE
11' 8"
24'
13' 4"
24'
b.
BREAK ROOM
FRONT OFFICE
11' 4"
9' 8"
d.
e.
6' 4"
8' 2"
8' 6"
7'
30'
f.
c.

NOTE: ALL WALLS ARE 4" THICK.

ALL EXTERIOR DOORS ARE 3' WIDE.

| MAVCC CONSTRUCTION | | |
|---|---|---|
| MURRAY OFFICE FLOOR PLAN | | |
| SCALE | DRAWN BY | SHEET |
| ¼" = 1' | AM | 1 of 4 |

## DESIGNING AND PLANNING A STRUCTURE
## UNIT C-2

### ASSIGNMENT SHEET #3—DESIGN A MODEL TRUSS BRIDGE

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Rules and regulations are followed | ______ |
| Design meets dimensions and specifications | ______ |
| Sketches and drawings are complete | ______ |
| Assignment is neat and completed on time | ______ |

A. Directions: Design a model truss bridge by using the steps in the design process.

1. Identify the design needs (problem).
2. Create preliminary sketches (collect ideas).
3. Refine the ideas.
4. Analyze the ideas.
5. Select a design.
6. Implement the design.

(NOTE: Your bridges must be designed to accommodate a test hook at the bridge's center (see instructor). Amount of wood glue will not be indicated but do not plan to laminate joints.)

B. Rules and Regulations:

1. The bridge must be constructed from no more than 15 pieces of 3/32" x 3/32" x 24" basswood.
2. Any common bonding materials (glue) may be used.
3. No other materials may be used.
4. The bridge must be symmetrical in all respects to a vertical axis through its geometric center.

## ASSIGNMENT SHEET #3

5. The top of the roadway must be at a height no greater than 30 mm above grade. Grade is defined as the level of the top surface of the test support.
6. No part of the bridge may extend below the grade.

C. Bridge Dimensions and Specifications:

| | Minimum | Maximum |
|---|---|---|
| Length | 250 mm | 300 mm |
| Width | 50 mm | No limit |
| Height | 50 mm | No limit |
| Weight | No minimum | 28 grams |

D. Students must complete and turn in the following items:

1. All rough sketches developed during the design process.
2. Detailed sketches of the proposed bridge.
3. A full size set of elevation drawings of the proposed bridge.

# DESIGNING AND PLANNING A STRUCTURE
## UNIT C-2

## ASSIGNMENT SHEET #4—DESIGN AND PLAN A GARDEN/UTILITY SHED

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Shed is properly designed | ______ |
| Construction is properly planned | ______ |
| Assignment is neat and completed on time | ______ |

Directions: Complete the following steps in groups or individually as directed by instructor.

A. Collect ideas for a garden/utility shed project.

Examples: Windows, size of door(s), size of shed, type of roof, type of floor, type of framing, interior features needed

B. Consider the following:

1. Function — Will the project do what it is supposed to do?
2. Appearance — Will the project look good and fit in with the setting around it?
3. Cost — Will the project be within the budget?
4. Strength — Will the project withstand the forces that it will be subjected to?
5. Materials — Which materials will be the best to use and are they available?

C. Select the desired characteristics for the garden/utility shed project.

D. Make or obtain working drawings. These must be complete with dimensions. Working drawings for this project include the following:

1. Floor plan
2. Exterior elevations (4)

E. Fill out the following bill of materials after working drawings have been completed for the proposed garden/utility shed project.

## ASSIGNMENT SHEET #4

| BILL OF MATERIALS | | | | |
|---|---|---|---|---|
| No. of Pieces | Description of Parts | Dimensions | Unit Cost | Total Cost |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

F. Estimate cost for materials based on instructor's directions.

G. Make a list of tools and equipment needed for the project.

(CAUTION: Safety tests must be completed and on file before using tools and equipment.)

### TOOLS AND EQUIPMENT LIST

## ASSIGNMENT SHEET #4

H. Make a list of individual job tasks that will need to be done to complete the garden/utility shed.

| JOB TASKS |
|---|
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |

## ASSIGNMENT SHEET #4

I. Refer back to the job tasks and now list them in the order in which they need to be done (scheduling). Estimate how many workers and how much time will be needed for each task.

**SCHEDULE**

| TASKS | NO. OF WORKERS | TIME NEEDED |
|---|---|---|
| | | |

(NOTE: Check with your instructor for additional duties. Job assignments can now be made and materials need to be ordered if not already available.)

## DESIGNING AND PLANNING A STRUCTURE
## UNIT C-2

## ANSWERS TO ASSIGNMENT SHEETS

**Assignment Sheet #1**

A. $24 \times 1' \times 12' \times 1" = 288$ board feet

B. $\frac{1' \times 8' \times 17'}{27} = \frac{136}{27} = 5$ cubic yards (rounded)

C. $\frac{6 \times 6" \times 12' \times 1"}{12} = 36$ board feet

D. $\frac{\frac{1}{2}' \times 6' \times 10'}{27} = \frac{30}{27} = 1$ cubic yard (rounded)

E. $12 \times 1" \times 1' \times 12' = 144$ board feet

F. $\frac{\frac{1}{3}' \times 3' \times 54'}{27} = \frac{54}{27} = 2$ cubic yards

**Assignment Sheet #2**

A.
1. Drawing area
2. Border line
3. Title block

B.
1. Dimension line
2. Visible line
3. Extension line

C. File room, manager's office, break room, front office

D.
1. 5
2. 2
3. 3

E. 30' x 24'

F.
1. 52 studs, $39.00
2. 108 studs, $81.00
3. 48 studs, $36.00

G. 11'4" x 11'8"

H. 4"

I. 2,0

J. Floor plan

## ANSWERS TO ASSIGNMENT SHEETS

**Assignment Sheets #3 and #4** — Evaluated according to the stated criteria

## DESIGNING AND PLANNING A STRUCTURE
## UNIT C-2

### LAB ACTIVITY SHEET #1 — DESIGN AND CONSTRUCT A PAPER TOWER ACCORDING TO STATED RULES

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Materials are used correctly | ______ |
| Regulations are followed | ______ |
| Tower is at least 20" tall. Additional points are given for taller towers. See D. below. | ______ |

A. Directions: Design and construct a paper tower from the materials listed below.

B. Materials

- 1 sheet of paper
- 20" of tape
- 1 ruler
- 1 pair of scissors

C. Regulations:

1. Time limit for construction is one class period.
2. The tower must be free standing.
3. The tower cannot be taped to the floor or any other support.
4. The tower must remain standing for 30 seconds during evaluation.

D. Evaluation: The paper tower is evaluated according to the following criteria.

20" --------> 5 points
22" --------> 10 points
24" --------> 15 points
26" --------> 20 points
28" --------> 25 points

30" --------> 30 points
35" --------> 35 points
40" --------> 40 points
45" --------> 45 points
50"+--------> 50 points

(NOTE: If a tower is taller than 30", the score will be equal to the number of inches the tower is tall.)

## DESIGNING AND PLANNING A STRUCTURE
## UNIT C-2

### TEST

Name ______________________________ Score ____________________

1. Match the terms on the right with the correct definitions.

______a. Permission to use the land

______b. Government regulations that determine how a building is to be built

______c. To determine the form and position of a tract of land

______d. Use of stonework and brickwork for construction

______e. Ratio of reduction or enlargement used on a drawing

______f. Drawing giving dimensions and other needed information for construction

______g. Powderlike substance that when mixed with water is used as a binding ingredient of mortar and concrete

______h. Framework of wood or metal members fastened together in the shape of a triangle

______i. Reproduction of an architect's or engineer's drawing

______j. Legal agreement between two or more persons or parties for the supply of specified goods or services at a fixed rate

1. Blueprint
2. Bridge
3. Building codes
4. Building permit
5. Cement
6. Contract
7. Contractor
8. Dimensions
9. Laminated
10. Masonry
11. Mortar
12. Scale
13. Specifications
14. Survey
15. Truss
16. Working drawing
17. Zoning ordinances

## TEST

2. Arrange in order the steps in designing and planning a structure by placing the correct sequence numbers (1-7) in the appropriate blanks.

______ a. Surveyors and/or engineers study the site for the planned structure.

______ b. Contractor obtains building permit.

______ c. Contractor orders materials and equipment and hires workers.

______ d. Designer makes working drawings and specifications. Owner approves them.

______ e. Owner meets with designer to begin design process. (Discusses needs and wants of owner and makes sketches.)

______ f. Designer checks local building codes and zoning ordinances.

5 g. Building contractor is selected. (May or may not include bidding process.)

3. Match the types of working drawings used in construction with the correct descriptions.

______ a. Drawings that show vertical imaginary cuts of a structure

______ b. Drawings that show horizontal imaginary cuts of a structure

______ c. Drawings that show how the sides of a structure will look

1. Elevations
2. Pictorials
3. Plans
4. Sections

4. Match the main parts of a working drawing with the correct descriptions.

______ a. Provides itemized list of number, description, and dimensions of each piece of material needed to construct an object

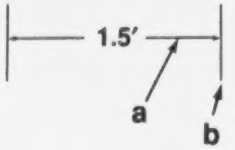
______ b. Contains different views of the object to be built including dimensions, symbols, notes, and other information

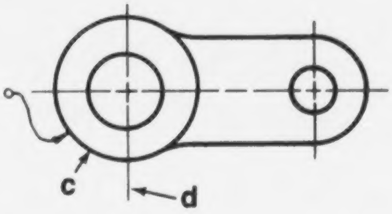
______ c. Contains basic information such as name and scale of drawing

1. Body
2. Bill of materials
3. Title block

# TEST

5. Identify the following types of lines used on working drawings.





a. ______________________________ c. ______________________________

b. ______________________________ d. ______________________________

6. Match materials commonly used in construction with the correct descriptions.

______a. Modified wood products bonded with glue and formed into boards such as waferboard

______b. Comes in 4′ x 8′ panels and can be used for subfloors

______c. A reddish metal that is easily worked; commonly used for wiring and plumbing pipes

______d. Primarily used for exterior and interior walls; includes bricks and stones

______e. Used to reduce heat transfer and noise; commonly made of fiberglass

______f. Very strong metal used for structural frames

______g. Hard, strong building material made by mixing cement, aggregate, and water

______h. Light metal that is commonly used for exterior siding

1. Aluminum
2. Concrete
3. Copper
4. Engineered panels
5. Glass
6. Insulation
7. Laminated timbers
8. Lumber
9. Masonry materials
10. Plastic
11. Plywood
12. Pressure-treated wood
13. Steel

## TEST

7. Apply the formulas for measuring construction materials to solve the following problems. Show your work.

$$\text{Volume in cubic yds} = \frac{\text{Length in feet} \times \text{Width in feet} \times \text{Thickness in feet}}{\text{27 cubic feet}}$$

$$\text{Board feet} = \frac{\text{Number of pieces} \times \text{Length in feet} \times \text{Width in inches} \times \text{Thickness in inches}}{12}$$

a. How many cubic yards of concrete are needed for a patio that measure 9′ x 9′ x 1′? ____________________

b. How many board feet are required for a project needing 6 boards each measuring 8′ x 12" x 1"? ____________________

8. Identify the information on the following bill of materials

| BILL OF MATERIALS | | |
|---|---|---|
| ⓐ | ⓑ | ⓒ |
| *1* | *#2 WHITE PINE* | *¾" X 7½" X 30½"* |
| *2* | *#2 WHITE PINE* | *¾" X 7½" X 14"* |
| *2* | *#2 WHITE PINE* | *¾" X 7½" X 32"* |
| *1* | *BIRCH DOWEL ROD* | *∅ 1" X 32"* |

a. ________________________________________

b. ________________________________________

c. ________________________________________

# TEST

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

9. Calculate quantities of construction materials. (Assignment Sheet #1)

10. Read a working drawing and calculate construction quantities and cost. (Assignment Sheet #2)

11. Design a model truss bridge. (Assignment Sheet #3)

12. Design and plan a garden/utility shed. (Assignment Sheet #4)

13. Design and construct a paper tower according to stated rules. (Lab Activity Sheet #1)

## DESIGNING AND PLANNING A STRUCTURE
## UNIT C-2

### ANSWERS TO TEST

1. a. 4 f. 16
   b. 3 g. 5
   c. 14 h. 15
   d. 10 i. 1
   e. 12 j. 6

2. a. 3 e. 1
   b. 6 f. 2
   c. 7 g. 5
   d. 4

3. a. 4
   b. 3
   c. 1

4. a. 2
   b. 1
   c. 3

5. a. Dimension line
   b. Extension line
   c. Visible (object) line
   d. Center line

6. a. 4 e. 6
   b. 11 f. 13
   c. 3 g. 2
   d. 9 h. 1

7. a. 3 cubic yards
   b. 48 board feet

8. a. Number of pieces (items)
   b. Description
   c. Dimensions

9.-13. Evaluated to the satisfaction of the instructor.

# BUILDING A STRUCTURE
# UNIT C-3

## UNIT OBJECTIVE

After completion of this unit, the student should be able to participate as a team member in the building of a structure. Competencies will be demonstrated by completing the lab activity sheets and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to building a structure with the correct definitions.
2. Arrange in order the steps in building a structure.
3. Match methods for clearing a site with the correct descriptions.
4. Identify types of concrete footings and foundations.
5. Identify parts of a floor frame.
6. Identify parts of a wall frame.
7. Identify parts of a roof frame.
8. Identify parts of a wall section.
9. Match common mechanical systems used in construction with the correct descriptions.
10. Categorize basic tools and equipment used in construction.
11. List precautions to follow in the safe use of construction tools.
12. Select true statements concerning personal safety rules.
13. Select true statements concerning lab safety rules.
14. Construct a model truss bridge. (Lab Activity Sheet #1)
15. Construct a garden/utility shed. (Lab Activity Sheet #2)

## BUILDING A STRUCTURE
## UNIT C-3

### SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher edition only and are designed to be used with the following objectives:

TM 1 — Basic Tools and Equipment Used in Construction — Objective 10

TM 2 — Safety Hazards — Objective 11-13

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information sheet.

F. Discuss information sheet.

G. Provide students with lab activity sheets.

H. Discuss and demonstrate the procedure outlined in the lab activity sheets.

I. Integrate the following activities throughout the teaching of this unit:

1. Use Teacher Supplement #1 to present AIT video C-3. This video was developed by the Agency for Instructional Technology (AIT) and a consortium of states to accompany this publication. Contact your state supervisor of technology education for copies, or contact AIT directly for more information:

   Agency for Instructional Technology (AIT)
   Box A, Bloomington, IN 47402
   800-457-4509 or 812-339-2203

2. Use Teacher Supplements #2 and #3 to help students understand this unit's terminology. Make copies (fronts only) for your students. The answers are on the back of the supplements.

3. Provide the following equipment for testing the students' model truss bridges in Lab Activity Sheet #1.

   a. Testing frame

   b. Testing block

   c. Testing hook

## SUGGESTED ACTIVITIES

    d. Two 5 gallon plastic pails
    e. 50 lbs clean sand
    f. Balance scales
    g. Calculator
    h. Evaluation sheet

4. Refer to Teacher Supplement #4 for building the testing block.
5. Videotape the bridge testing and use the videotape for motivation and promotion of the program.
6. Display safety posters that deal with construction safety.
7. Discuss the skills that will be developed through the garden/utility shed construction activity and how those skills could lead to various careers.
8. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

J. Administer test.

K. Evaluate test.

L. Reteach if necessary.

## REFERENCES USED IN DEVELOPING THIS UNIT

A. Bame, E. Allen and Paul Cummings. *Exploring Technology*. Worcester, MA: Davis Publications, 1980.

B. Barnes, Bruce. *Bridges*. Mound, MN: Scholastic Futures Publishing, 1989.

C. Fales, James F., et al. *Technology Today and Tomorrow*. Mission Hills, CA: Glencoe/McGraw-Hill, 1988.

D. Feirer, John L. and John R. Lindbeck. *Production Technology*. Mission Hills, CA: Glencoe/McGraw-Hill, 1985.

E. Henak, Richard M. *Exploring Construction*. South Holland, IL: The Goodheart-Willcox Company, Inc., 1985.

F. Hendrix, Laborn J. "Bud". *Residential Carpentry*. Stillwater, OK: Oklahoma State Board of Vocational and Technical Education, 1985.

G. *Industrial and Technical Education: A Guide for Curriculum Designers, Implementors, and Teachers*. Lansing, Illinois. Technical Foundation of America.

## SUGGESTED ACTIVITIES

H. *Jackson's Mill Industrial Arts Curriculum Theory.* Charleston, West Virginia. West Virginia Department of Education.

I. Landers, Jack M. *Construction: Materials, Methods, Careers.* South Holland, IL: Goodheart-Willcox Company, Inc., 1983.

J. Lux, Donald G., et al. *World of Construction.* Mission Hills, CA: Glencoe/McGraw-Hill, 1988.

K. Williams, Charles F., et. al. *Technology for Tomorrow.* Cincinnati, OH: South-Western Publishing Company, 1985.

L. Wright, R. Thomas and Howard Bud Smith. *Understanding Technology.* South Holland, IL: Goodheart-Willcox Company, Inc., 1989.

## SUGGESTED SUPPLEMENTAL RESOURCES

A. Films and videos

1. *The Foundation* and *Wood Shell*, films. Available from:

   The University of Wisconsin
   Bureau of Audio-Visual Instruction
   P.O. Box 2093
   Madison, Wisconsin 53701-2093

2. *Construction Systems Technology: Building the Structure*, video.

3. *Basic House Framing*, video.

   2 and 3 are available from:

   Bergwall Productions, Inc.
   P.O. Box 238
   Garden City, NY 11530-0238
   800-645-3565

4. *Power Tool Safety: A Skill You Need on the Job*, video. Available from:

   Black and Decker (U.S.), Inc.
   P.O. Box 798
   10 North Park Drive
   Hunt Valley, MD 21030

5. *Building a Structure Safely*, 14 min. Available from:

   Agency for Instructional Technology
   Box A
   Bloomington, IN 47402
   800-457-4509

## SUGGESTED ACTIVITIES

6. *Basic Carpentry.* Covers tools and basic wall framing.

7. *Plumbing.*

8. *Electrical.*

6-8 are available from:

Hearlihy and Co.
714 West Columbia
P.O. Box 869
Springfield, OH 45501
800-622-1000

B. Construction software (Apple, IBM, TRS-80, others)

1. *Tools*

2. *Framing Processes*

Available from:

National Innovative Media Co.
Route #2, Box 301B
Calhoun, KY 42327
800-962-6662

C. Bridge building materials (balsa and basswood sticks, glue, etc.) are available from:

Midwest Products Co., Inc.
400 S. Indiana St.
P.O. Box 564
Hobart, IN 46342
219-942-1134

or

Pitsco
P.O. Box 1328
Pittsburg, KS 66762
800-835-0686

(Pitsco also has a bridge tester as well as bridge building materials.)

## BUILDING A STRUCTURE
## UNIT C-3

### TEACHER SUPPLEMENT #1—USING AIT VIDEO C-3

**Introduction and Program Summary (13:46)**

This program introduces the specific steps and processes used to prepare the site and erect the framework of a strong and safe structure. Different size buildings and sites require different kinds of foundations. When a foundation gives way, the building it supports will crumble. Viewers see speeded-up footage of a house being moved to a stronger foundation.

The first step in building a safe structure is to survey and prepare the site. A builder is profiled who explains that in building a house, a footing of concrete is poured on solid soil below the frost line. A foundation wall of masonry blocks is built on the footing. This may be waterproofed or insulated. With time-lapse photography, viewers see floor joists, subfloor, and framing walls rise on the foundation. Weather can interrupt the building process. Ceiling joists, upper story walls, and the roof are added to enclose the building. Other structures, such as skyscrapers, follow a similar construction process, but use steel instead of wood frames. The house of the future may be made of plastic compounds, which offer flexibility and fire and water proofing. Viewers are asked to think of other ways plastics could be used in construction.

**Video Program Objectives**

The video program will illustrate the basic steps involved in erecting a structure.

**Before the Program**

1. Ask your students if they would want to live in a residence that might sink into the earth, wash away to sea, or blow away in a strong wind? Tell them some structures that were not built safely have met this fate.

2. Tell students what they will be doing in the lab, and how the content of the video program will set the stage for the laboratory activity.

3. Tell students to note the following in the video program: steps in building safe structures; elements all structures have in common; special preparations to ensure that the structure lasts; and advantages of specific building materials.

4. Tell students to listen for the following terms. (You might write them on the chalkboard.)

   foundation
   survey
   frostline
   framing
   roofing system
   ultrasound
   footing
   site
   mason
   nail gun
   carpenter
   slab
   excavation
   joists
   prebuilt walls
   landscaping

## TEACHER SUPPLEMENT #1

**After the Program: Questions for Discussion and Review**

1. What does every structure have in common? *(the foundation)*
2. What are the options when a bad foundation exists? *(reinforce it, replace it, or move the structure)*
3. Why do the people of the Netherlands drive concrete posts deep into the earth when they build a structure? *(to set their foundations on bedrock, which is far below the wet sandy soil)*
4. What are the basic steps in building a house? *(surveying the site; locating and marking the boundaries; laying out the locations of foundations; excavating; pouring footings for the foundation below the frostline; laying block for the foundation; installing sill plate; nailing in floor joists; laying subfloors; raising framing and walls; framing interior walls; nailing ceiling joists; framing the roofing system, consisting of rafters and/or prebuilt trusses; adding the roofing materials—sheathing, tar paper, and shingles; enclosing the building completely by adding windows and doors; roughing in the subsystems—electrical, plumbing, and heating and cooling; finishing exterior and interior surfaces; landscaping)*
5. What is a "footer" and its function? *(The widest part of the foundation system, the footer distributes the weight of the building over a larger area.)*
6. In a prebuilt wall, the framing and sheathing are assembled and then brought to the site. What are the advantages of doing this? *Work can proceed indoors regardless of weather. The house can then be enclosed very quickly.)*
7. How are plastics being used in the GE house? *(for roof shingles, siding, molding, insulation, and wall panels)*
8. How else could we use plastics in home construction? *(class discussion)*

# BUILDING A STRUCTURE
## UNIT C-3

## TEACHER SUPPLEMENT #2—CRISS CROSS PUZZLE

Name ______________________________ Date ____________________

Directions: Write the words that go with the clues in the space next to the clue, then fit the words into the criss cross pattern.

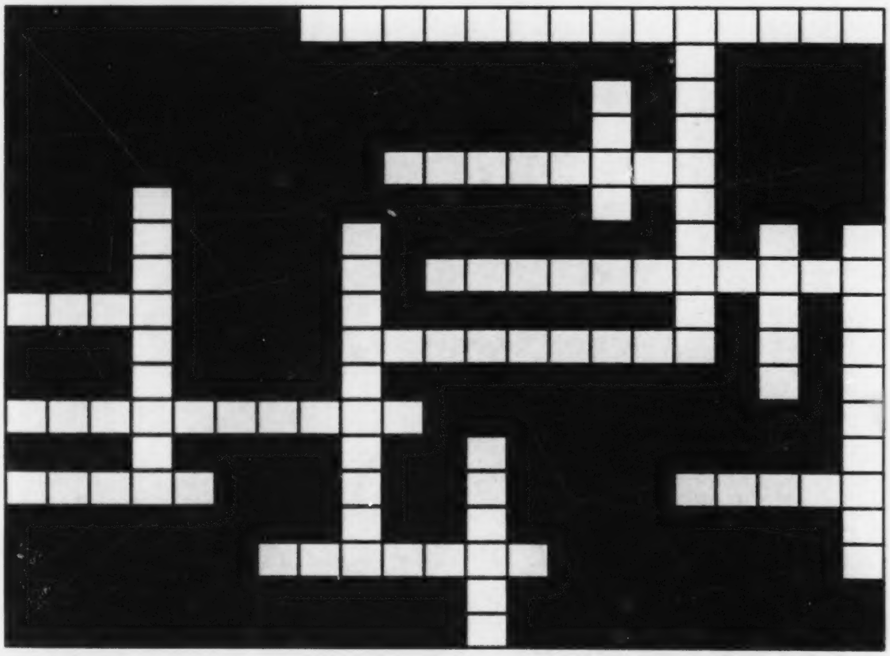
ACROSS CLUES

WORDS

Non-load bearing walls
Shoveling, dredging, dozing
The first layer of material on a floor
Shovels, levels, hammers, saws, etc.
Bulldozers, cranes, trucks, etc.
Vertical framing member in a wall
Keep all hand tools ______ and clean
Safety ______ must be worn at all times
Horizontal framing member in a floor

DOWN CLUES

________ systems include electrical and plumbing
The steepness of a roof
The top part of a structure
Circular saws, jig saws, power trowels, etc.
Capable of transmitting electricity
Roof framing member from wall to ridge
Gravel and sand



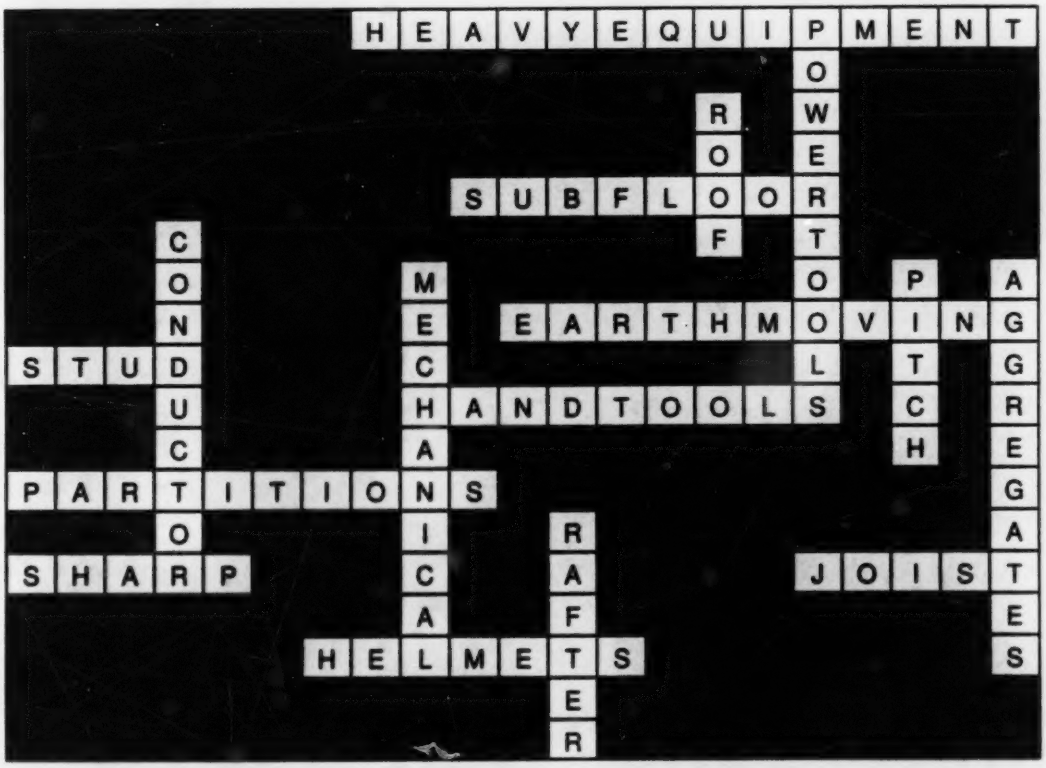
*Duplication Permitted*

## TEACHER SUPPLEMENT #2

## CRISS CROSS PUZZLE ANSWER KEY

| ACROSS CLUES | WORDS |
|---|---|
| Non-load bearing walls | PARTITIONS |
| Shoveling, dredging, dozing | EARTH MOVING |
| The first layer of material on a floor | SUBFLOOR |
| Shovels, levels, hammers, saws, etc. | HAND TOOLS |
| Bulldozers, cranes, trucks, etc. | HEAVY EQUIPMENT |
| Vertical framing member in a wall | STUD |
| Keep all hand tools ______ and clean | SHARP |
| Safety ______ must be worn at all times | HELMETS |
| Horizontal framing member in a floor | JOIST |

| DOWN CLUES | |
|---|---|
| ________ systems include electrical and plumbing | MECHANICAL |
| The steepness of a roof | PITCH |
| The top part of a structure | ROOF |
| Circular saws, jig saws, power trowels, etc. | POWER TOOLS |
| Capable of transmitting electricity | CONDUCTOR |
| Roof framing member from wall to ridge | RAFTER |
| Gravel and sand | AGGREGATES |


HEAVYEQUIPMENT
ROOF
POWERTOOLS
SUBFLOOR
CONDUCTOR
MECHANICAL
PITCH
AGGREGATES
EARTHMOVING
STUD
HANDTOOLS
PARTITIONS
RAFTER
SHARP
JOIST
HELMETS

*Duplication Permitted*

## BUILDING A STRUCTURE
## UNIT C-3

### TEACHER SUPPLEMENT #3—WORD SCRAMBLE

Name ______________________________ Date ________________

Directions: Unscramble the letters to form words we are studying. Write the words in the spaces on the right.

1. UDST ________________
2. OIMLTNEODI ________________
3. ERFRTA ________________
4. EWRLTOOSPO ________________
5. TQEUEYAHEMNIVP ________________
6. IOENHMTGVAR ________________
7. IOSTJ ________________
8. NSTTRPOIAI ________________
9. NI-OGHRU ________________
10. GFOTONI ________________
11. APSHR ________________
12. LAHNCEAMIC ________________
13. FORO ________________
14. ROOBSUFL ________________
15. ESMLTHE ________________
16. PHCIT ________________
17. IEHPQMNETTLUGI ________________
18. TOLSAONDH ________________
19. TCCODUORN ________________
20. EAEGTGGRA ________________

*Duplication Permitted*

## TEACHER SUPPLEMENT #3

## WORD SCRAMBLE ANSWER KEY

| | | |
|---|---|---|
| 1. | UDST | STUD |
| 2. | OIMLTNEODI | DEMOLITION |
| 3. | ERFRTA | RAFTER |
| 4. | EWRLTOOSPO | POWER TOOLS |
| 5. | TQEUEYAHEMNIVP | HEAVY EQUIPMENT |
| 6. | IOENHMTGVAR | EARTHMOVING |
| 7. | IOSTJ | JOIST |
| 8. | NSTTRPOIAI | PARTITIONS |
| 9. | NI-OGHRU | ROUGH-IN |
| 10. | GFOTONI | FOOTING |
| 11. | APSHR | SHARP |
| 12. | LAHNCEAMIC | MECHANICAL |
| 13. | FORO | ROOF |
| 14. | ROOBSUFL | SUBFLOOR |
| 15. | ESMLTHE | HELMETS |
| 16. | PHCIT | PITCH |
| 17. | IEHPQMNETTLUGI | LIGHT EQUIPMENT |
| 18. | TOLSAONDH | HANDTOOLS |
| 19. | TCCODUORN | CONDUCTOR |
| 20. | EAEGTGGRA | AGGREGATE |

***Duplication Permitted***

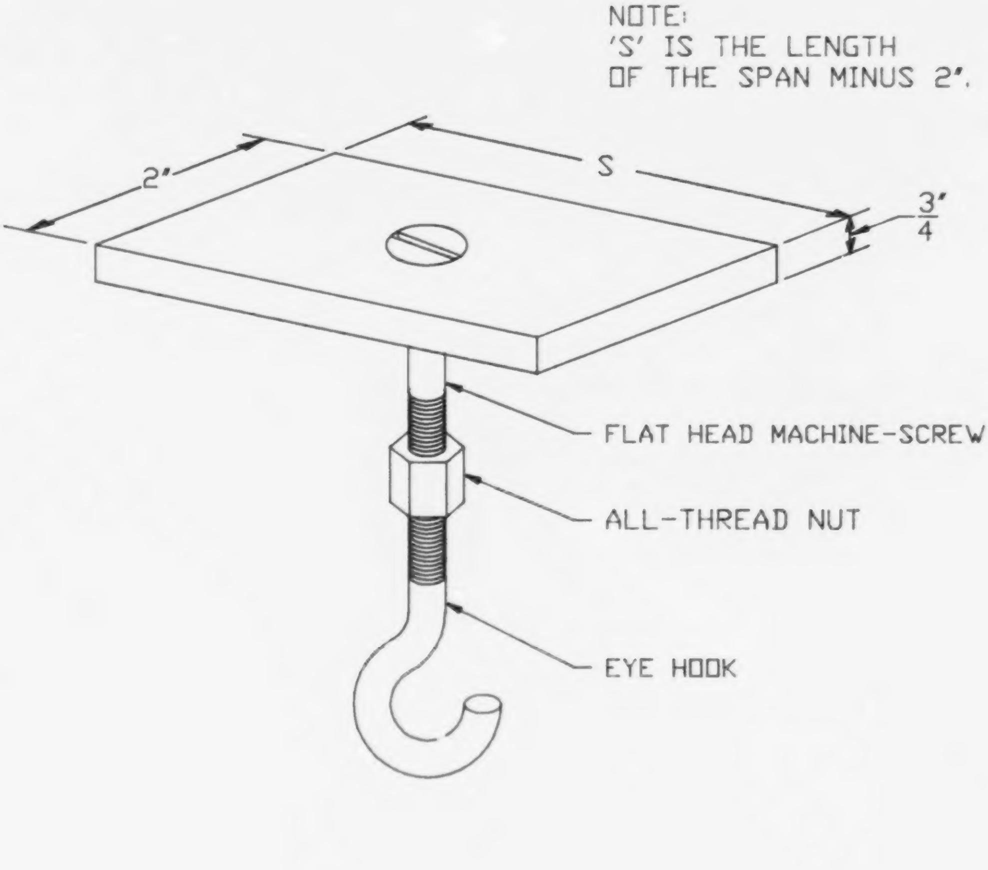
# BUILDING A STRUCTURE
## UNIT C-3

## TEACHER SUPPLEMENT #4—TEST BLOCK SPECIFICATIONS

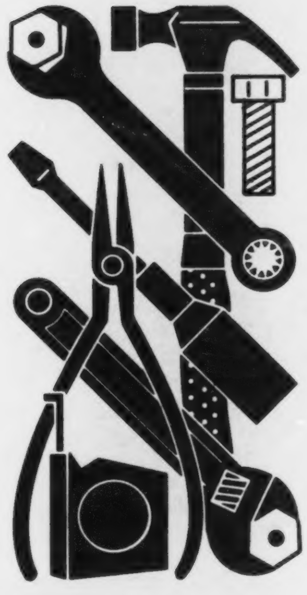
(NOTE: This test system is for concentrated stress testing.)

A. Bridge must accommodate test block on the roadbed and allow for the bolt to protrude through the bottom of the bridge. (S is the length of the span minus 2".)

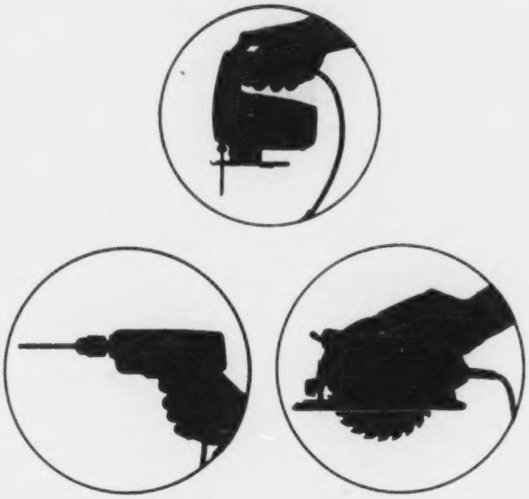
B. After the block is in place, the hook will be attached and a load can then be applied to the hook.


NOTE:
'S' IS THE LENGTH
OF THE SPAN MINUS 2".
2"
S
3/4"
FLAT HEAD MACHINE-SCREW
ALL-THREAD NUT
EYE HOOK

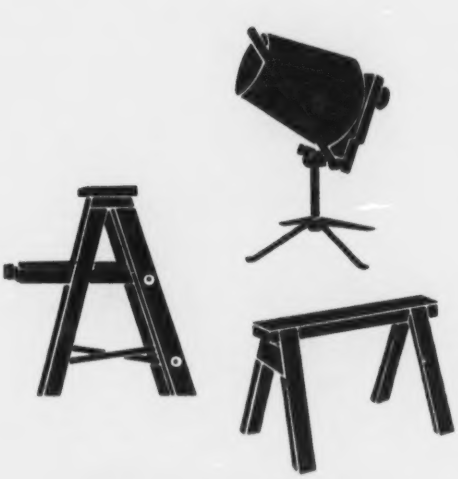
# Basic Tools and Equipment Used in Construction



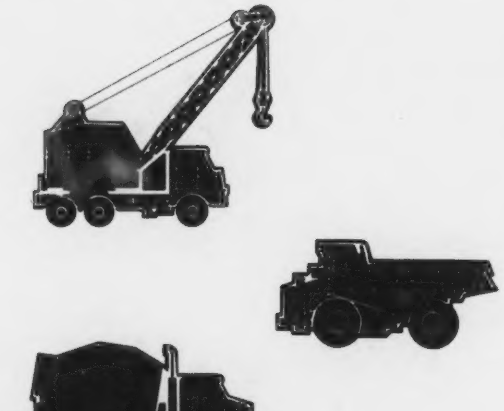
Hand Tools



Power Tools

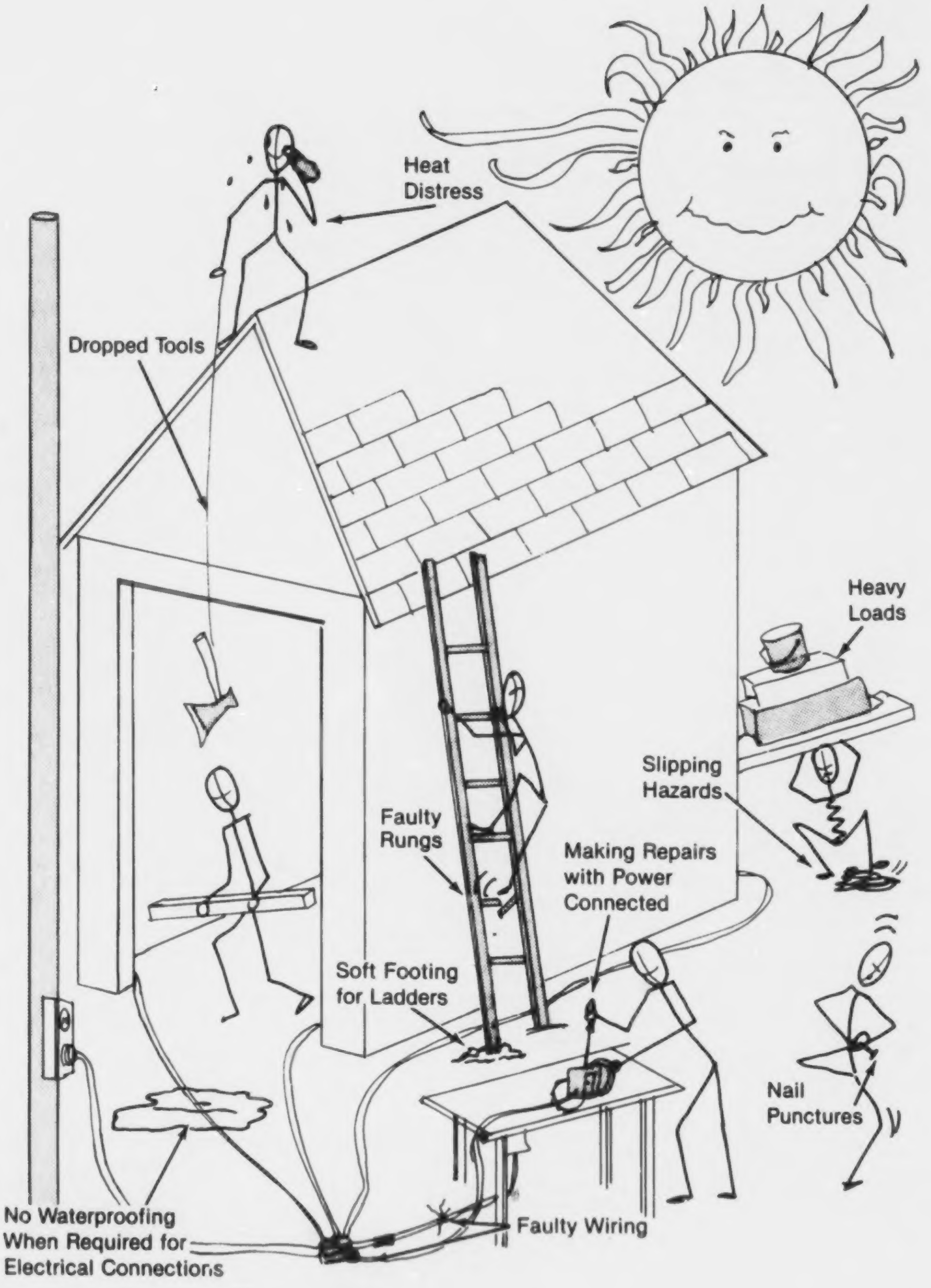


Light Equipment



Heavy Equipment

# Safety Hazards


Heat Distress
Dropped Tools
Heavy Loads
Slipping Hazards
Faulty Rungs
Making Repairs with Power Connected
Soft Footing for Ladders
Nail Punctures
No Waterproofing When Required for Electrical Connections
Faulty Wiring

# BUILDING A STRUCTURE
## UNIT C-3

## INFORMATION SHEET

I. **Terms and definitions**

   A. Aggregates — Materials such as sand and gravel used to give bulk and body to concrete

   B. Conductor — A substance capable of transmitting electricity, heat, or sound

   C. Footing (footer) — Enlarged base upon which a foundation wall, pier, or column rests; helps distribute the load

   D. Joist — Horizontal framing member in the ceiling and floor

   E. Load-bearing walls — Walls that support the weight of the structure

   F. Partitions — Interior dividing walls that do not support the weight of the structure

   G. Pitch — The steepness of the roof

   H. Prefabricated — Parts that are constructed in a factory and assembled on site

   I. Rafter — Roof framing member that extends from wall to roof ridge (peak)

   J. Rebars — Steel bars of various sizes used to reinforce concrete

   K. Rough-in — Preliminary, unfinished mechanical work including HVAC ductwork, plumbing pipes, and electrical and gas lines

   L. Sheathing — The first layer of wall covering on the exterior of walls

   M. Stud — Vertical framing member in a wall

   N. Subfloor — First layer of material applied over the floor joists

   O. Wire mesh reinforcement — Roll or sheet of welded wire mesh used in flat concrete work such as floor slabs, pavements, and sidewalks

II. **Steps in building a structure**

   A. Clear site.

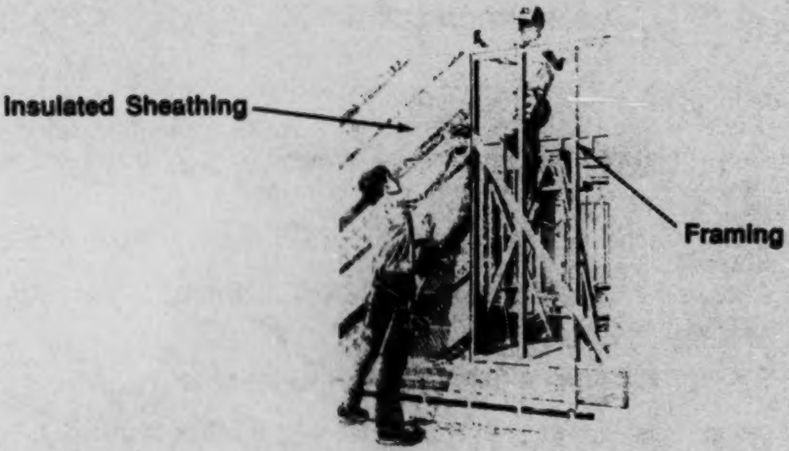
   B. Build footings and foundation; inspect.

   C. Build superstructure (framing); inspect.

   D. Enclose structure with sheathing.

   E. Rough-in mechanical systems; inspect.

## INFORMATION SHEET



III. **Methods for clearing a site**

A. Cutting — Includes sawing and chopping to remove trees and brush

B. Demolition — Includes blasting with plastic explosives and dynamite or wrecking to remove existing structures or obstacles

C. Salvage — Removing materials of value and storing them to sell

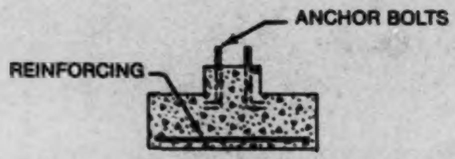
D. Disposal — Includes hauling away demolished material or burning material

(NOTE: You must have a permit to burn.)

E. Earthmoving — Includes shoveling, dredging, and dozing to level the site

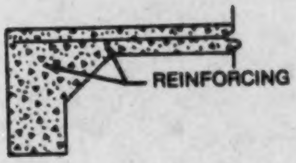
IV. **Types of concrete footings and foundations**

A. Spread footing

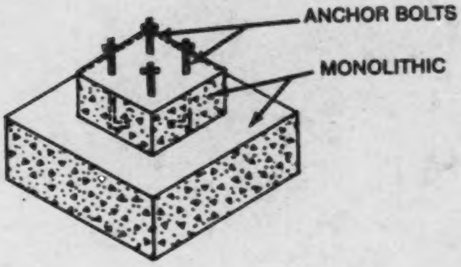


## INFORMATION SHEET

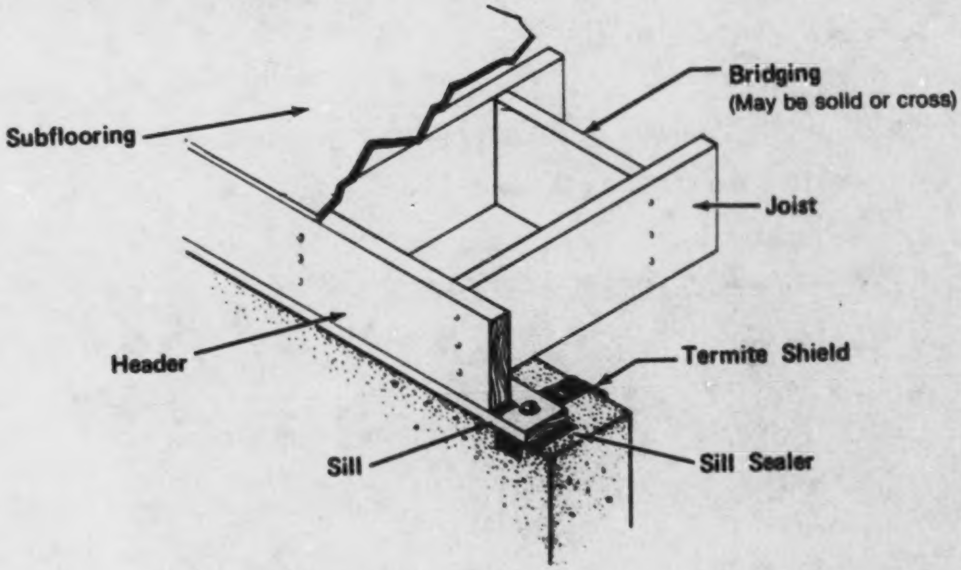
B. Slab (on grade) poured monolithic


REINFORCING

C. Pier footing

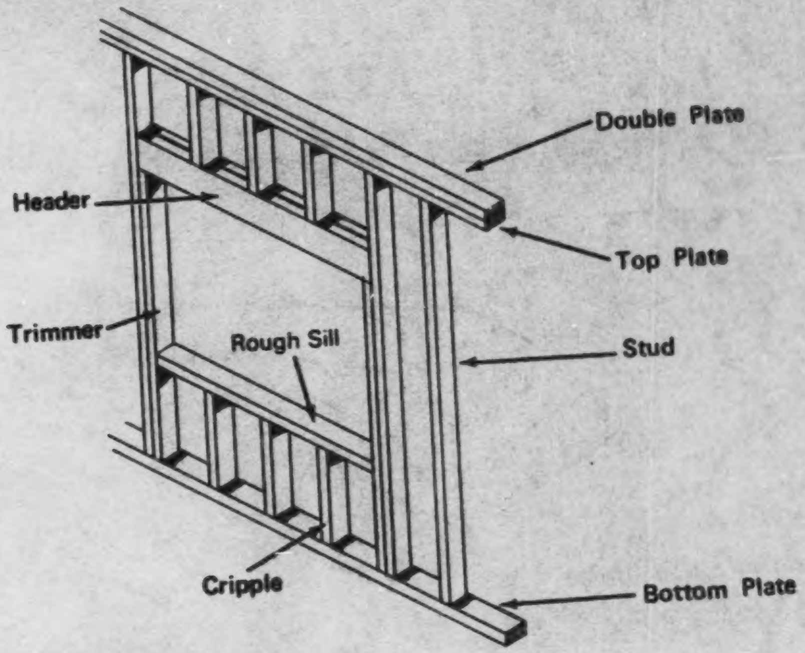

ANCHOR BOLTS
MONOLITHIC

## V. Parts of a floor frame

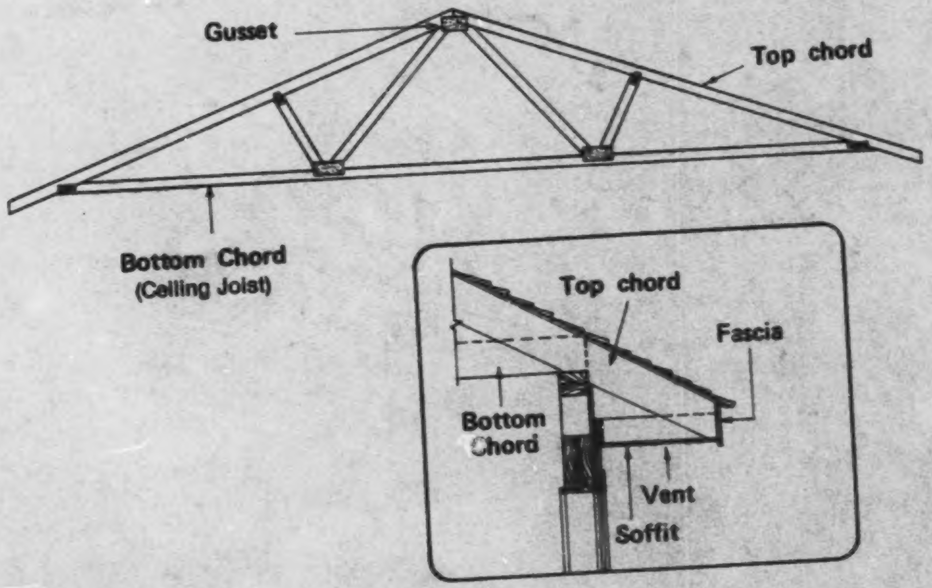

Subflooring
Bridging
(May be solid or cross)
Joist
Header
Termite Shield
Sill
Sill Sealer

## INFORMATION SHEET

### VI. Parts of a wall frame

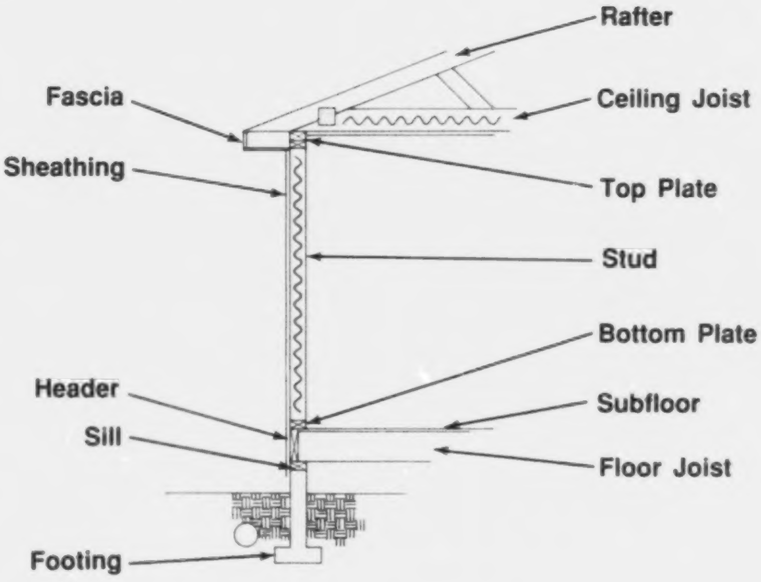

Double Plate
Header
Top Plate
Trimmer
Rough Sill
Stud
Cripple
Bottom Plate

### VII. Parts of a roof frame (truss)


Gusset
Top chord
Bottom Chord
(Ceiling Joist)
Top chord
Fascia
Bottom Chord
Vent
Soffit

## INFORMATION SHEET

### VIII. Parts of a wall section


Rafter
Fascia
Ceiling Joist
Sheathing
Top Plate
Stud
Bottom Plate
Header
Subfloor
Sill
Floor Joist
Footing

### IX. Common mechanical systems used in construction

A. Electrical — For operating mechanical equipment, lighting, and most appliances

B. Plumbing — For providing fresh hot and cold water and for removing waste water

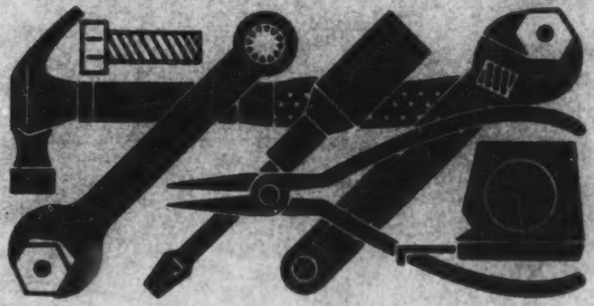
C. Climate control — For heating, cooling, and ventilating building interiors

D. Other systems — For special needs of a structure such as natural gas supply, security, cable TV, solar energy, special transportation, or telephone service

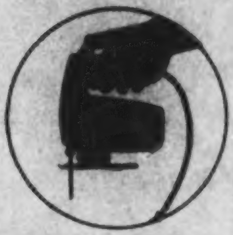
## INFORMATION SHEET

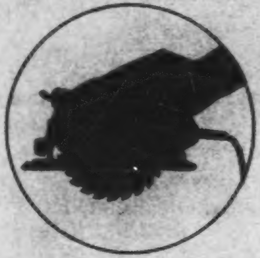
### X. Basic tools and equipment used in construction

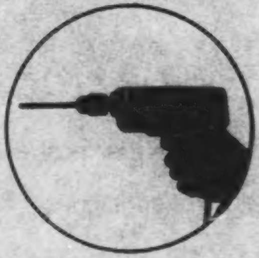
A. Hand tools — Simple tools that include hammers, saws, wrenches, shovels, levels, tape measures, trowels, squares, and screwdrivers.



B. Power tools — Tools that are powered by electricity or air; include power trowels, jig saws, table saws, jointers, radial arm saws, circular saws, nailers, and staplers

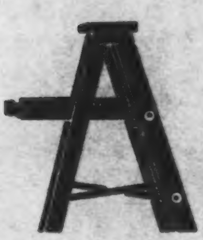


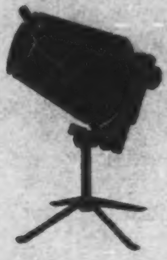


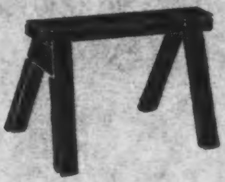


## INFORMATION SHEET

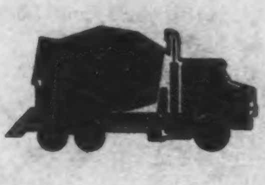
C. Light equipment — Equipment that can be moved about easily; includes ladders, cement mixers, sawhorses, and wheelbarrows.

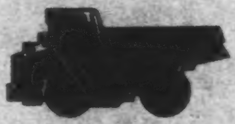


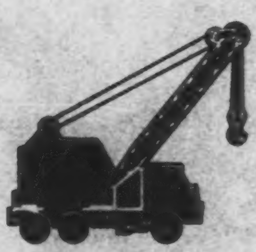




D. Heavy equipment — Large and powerful equipment; includes cranes, bulldozers, trucks, and road graders.







XI. **Safe use of construction tools**

A. Do not drop tools.

B. Keep tools clean.

C. Keep tools sharp.

D. Return tools to storage cabinet after use.

E. Keep tools dry and oiled.

F. Use tools only for their intended purposes.

## INFORMATION SHEET

**XII. Personal safety rules**

- A. Safety helmets must be worn at all times.
- B. Do not leave equipment with the motor running.
- C. Wear laboratory clothing appropriate to the activity being performed.
- D. Remove rings and other jewelry when working in the laboratory.
- E. Conduct oneself in a manner conducive to safe laboratory practices.
- F. Always wear safety glasses when needed.
- G. Keep hands clean.

**XIII. Lab safety rules**

- A. Keep all hand tools sharp, clean, and in safe working order.
- B. Report any defective tools, machines, or other equipment to the instructor.
- C. Report all accidents to the instructor regardless of nature of severity.
- D. Keep the laboratory floor and work area clear of scraps and litter.
- E. Clean up any spilled liquids immediately.
- F. Properly dispose of combustible materials or store in approved containers.
- G. Keep aisles, traffic areas, and exits clear.
- H. Keep materials, supplies, and tools properly stacked or stored.

## BUILDING A STRUCTURE
## UNIT C-3

## LAB ACTIVITY SHEET #1—CONSTRUCT A MODEL TRUSS BRIDGE

Name ______________________ Overall Rating __________

| EVALUATION CRITERIA | RATING |
|---|---|
| Bridge is constructed properly | ______ |
| Bridge is neat | ______ |
| Bridge passes stress test | ______ |

A. Tools and materials

1. Basswood (Balsa) wood strips, 3/32" x 3/32" x 24"
2. White glue
3. Scroll or band saw
4. Straight pins
5. Ruler, 12"
6. Testing equipment provided by instructor

B. Procedure

1. Follow instructor's directions for setting up work area.
2. Using design you developed in previous unit, cut strips of wood for trusses.
3. Construct bridge by joining the wood pieces together with the white glue.
4. Use straight pins to hold glue joints together until dry.
5. Store bridge in drying area and clean up work area.
6. Allow to dry a minimum of 18 hours.
7. Measure and record amount of wood used in the construction of the bridge.
8. Measure and record width and span.
9. Test bridge according to instructor's directions.
10. Calculate efficiency using the following formula and evaluate by TSA competitive event guidelines:

$$\text{EFFICIENCY} = \frac{\text{FAILURE WEIGHT}}{\text{LENGTH OF WOOD USED}}$$

11. Clean up test area.

## BUILDING A STRUCTURE
## UNIT C-3

### LAB ACTIVITY SHEET #2 — CONSTRUCT A GARDEN/UTILITY SHED

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Shed is constructed correctly | ______ |
| Work is neat | ______ |
| Safety rules are followed | ______ |

(NOTE: Refer to the design plans made or obtained in the previous unit.)

A. Materials

1. 2x4's (studs and floor joists)
2. Siding (sheathing)
3. Plywood (roof sheathing and subfloor)
4. Tar paper
5. #16 box nails
6. 4" x 4" treated lumber (skids)

B. Equipment

1. Radial arm saw
2. Hammers
3. Nail pullers
4. Table saw
5. Level
6. Square
7. Hand saw
8. Power saw
9. Utility knife

## LAB ACTIVITY SHEET #2

C. Procedure

1. Follow instructor's directions for setting up work area.
2. Cut the floor joists to length.
3. Cut the floor joist headers to length.
4. Assemble the floor joists and headers.
5. Attach the skids to the bottom of the floor joists and headers.
6. Cut and fasten the subfloor to the floor joists and headers.
7. Cut the studs and plates to length for wall framing.
8. Assemble each wall separately.
9. Place each wall (one at a time) in position and fasten to the floor. Brace each wall.

   (NOTE: Make sure each wall is square.)
10. Attach the top plate to the walls so they overlap the walls to tie each wall together.
11. Cut the ceiling joist to length and attach to top of the top plate.
12. Cut the rafters to size.
13. Cut the ridgeboard and support to length and attach to the top of the shed.
14. Attach the rafters to the top plate, ceiling joist, and ridgeboard.
15. Cut and fasten plywood to the roof.

    (NOTE: Make sure each side of the roof is square.)
16. Fasten the tar paper to the roof.

(NOTE: Finish work and inspection will be done in the next unit.)

## BUILDING A STRUCTURE
## UNIT C-3

## TEST

Name ________________________________ Score ____________________

1. Match the terms on the right with the correct definitions.

______a. Vertical framing member in a wall

______b. Horizontal framing member in the ceiling and floor

______c. The first layer of wall covering on the exterior of walls

______d. Roof framing member that extends from wall to roof ridge (peak)

______e. Enlarged base upon which foundation wall, pier, or column rests; helps distribute the load

______f. First layer of material applied over the floor joists

______g. Interior dividing walls that do not support the weight of the structure

______h. The steepness of the roof

______i. Materials such as sand and gravel used to give bulk and body to concrete

______j. Steel bars of various sizes used to reinforce concrete

1. Aggregates
2. Conductor
3. Footing
4. Joist
5. Load-bearing walls
6. Partitions
7. Pitch
8. Prefabricated
9. Rafter
10. Rebars
11. Rough-in
12. Sheathing
13. Stud
14. Subfloor

2. Arrange in order the steps in building a structure by placing the correct sequence numbers (1-5) in the appropriate blanks.

______a. Build superstructure; inspect.

______b. Enclose structure with sheathing.

______c. Clear site.

______d. Build footings and foundation; inspect.

______e. Rough-in mechanical systems; inspect.

## TEST

3. Match methods for clearing a site with the correct descriptions.

_____a. Includes shoveling, dredging, and dozing to level the site

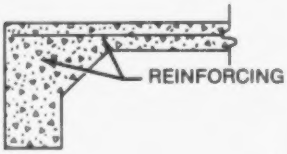
_____b. Includes hauling away demolished material or burning material

_____c. Includes sawing and chopping to remove trees and brush

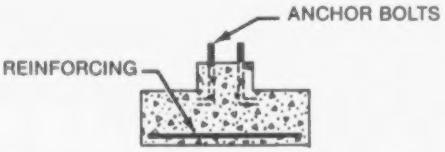
_____d. Removing materials of value and storing them to sell

1. Cutting
2. Demolition
3. Disposal
4. Earthmoving
5. Salvage

4. Identify the concrete footings and foundations shown.

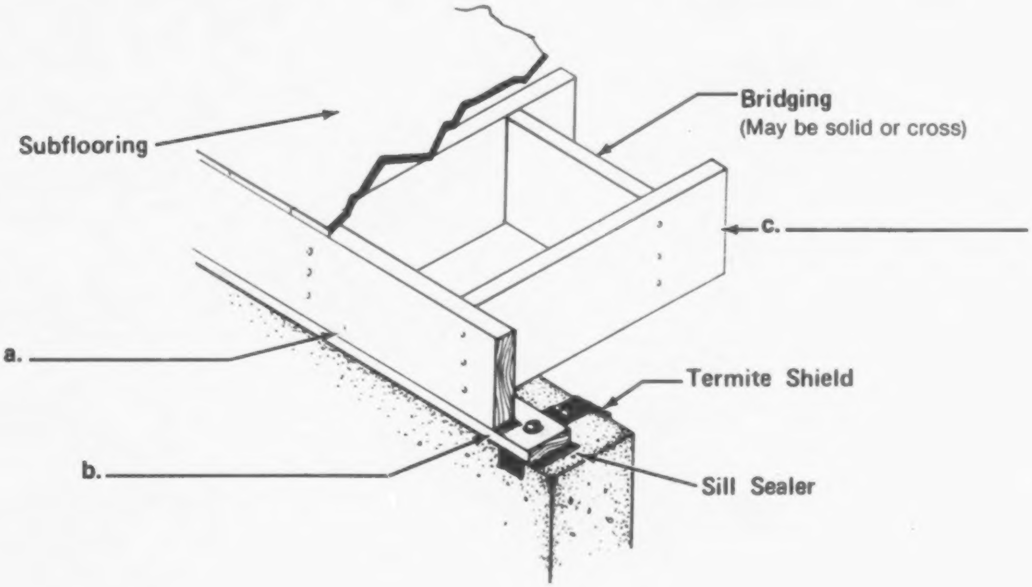

REINFORCING

a.______________________________


ANCHOR BOLTS
REINFORCING

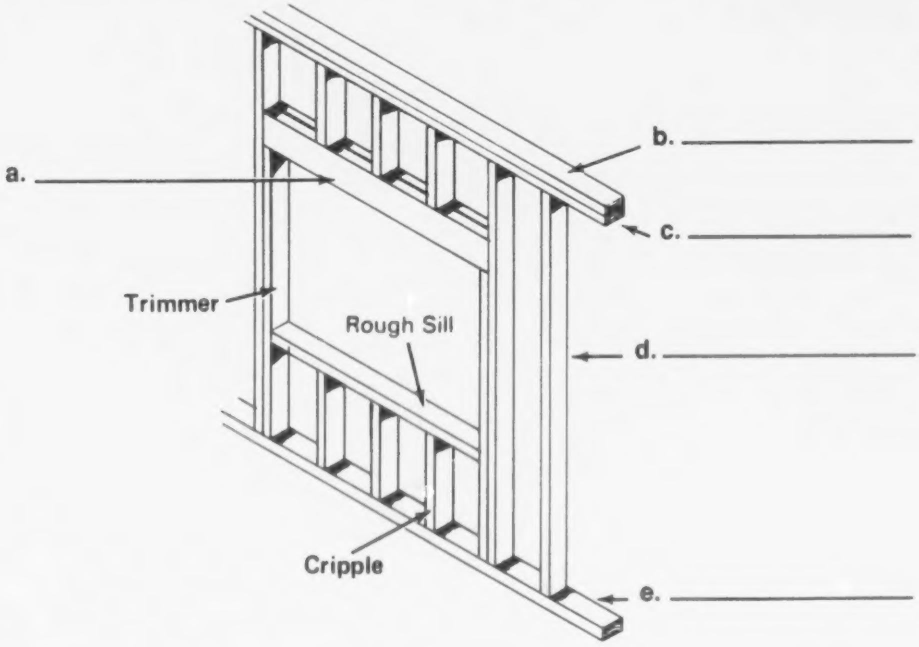
b.______________________________

5. Identify the missing parts of a floor frame.

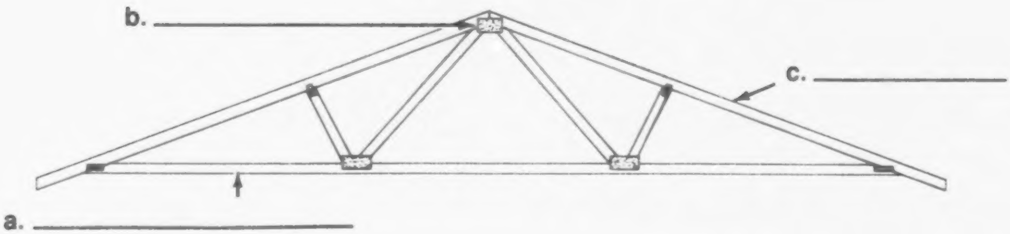

Subflooring
Bridging
(May be solid or cross)
c. ______________
a. ______________
Termite Shield
b. ______________
Sill Sealer

## TEST

6. Identify the missing parts of a wall frame.

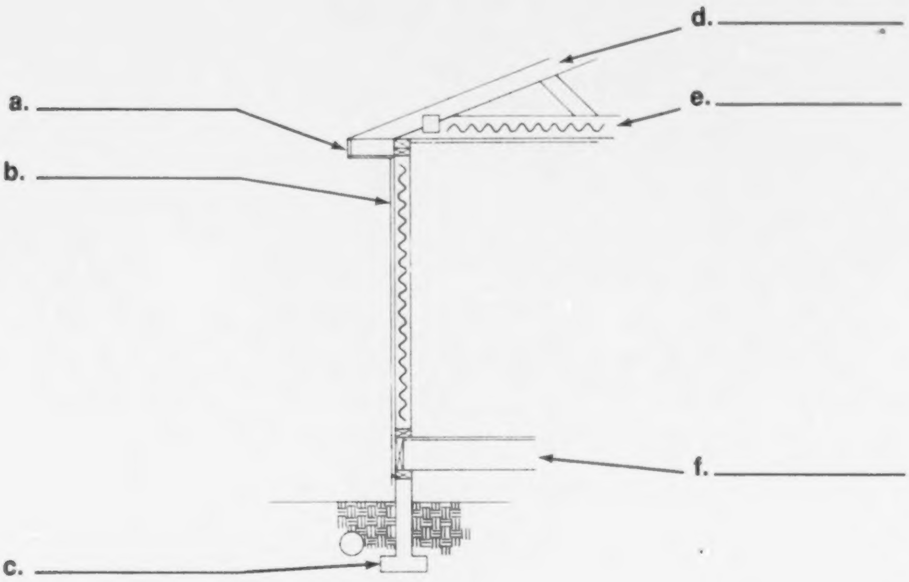

a. ______
b. ______
c. ______
Trimmer
Rough Sill
d. ______
Cripple
e. ______

7. Identify the parts of a roof frame.



## TEST

8. Identify the missing parts of a wall section.



9. Match common mechanical systems used in construction with the correct descriptions.

______a. For operating mechanical equipment, appliances, and lighting

______b. For heating, cooling, and ventilating building interiors

______c. For providing fresh hot and cold water and for removing waste water

1. Climate control
2. Electrical
3. Plumbing
4. Other

10. Categorize the basic tools used in construction as (HT) hand tools, (PT) power tools, (LE) light equipment, or (HE) heavy equipment.

______a. Level

______b. Truck

______c. Circular saw

______d. Hammer

______e. Jig saw

______f. Crane

______g. Ladder

______h. Wheelbarrow

______i. Wrench

______j. Bulldozer

## TEST

11. List three precautions to follow in the safe use of construction tools.

a.________________________________________

b.________________________________________

c.________________________________________

12. Select true statements concerning personal safety rules by placing a "T" in the blanks next to the true statements and an "F" next to the false statements.

______a. Wear safety glasses only when instructor is present.

______b. Conduct yourself in a manner conducive to safe laboratory practices.

______c. Remove rings and other jewelry when working in the laboratory.

______d. Keep hands clean.

______e. Wear any type of clothing you wish when in the laboratory.

______f. Wear long chains or scarves as you wish.

13. Select true statements concerning correct rules for laboratory safety by placing a "T" next to the true statements and an "F" next to the false statements.

______a. Toss defective tools in trash can immediately.

______b. Keep aisles, traffic areas, and exits clear.

______c. Report all accidents to the instructor regardless of severity.

______d. Use tools only if they are dull.

______e. Ignore spills on the floor.

______f. Keep materials, supplies, and tools properly stacked.

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

14. Construct a model truss bridge. (Lab Activity Sheet #1)

15. Construct a garden/utility shed. (Lab Activity Sheet #2)

## BUILDING A STRUCTURE
## UNIT C-3

### ANSWERS TO TEST

1. a. 13
   b. 4
   c. 12
   d. 9
   e. 3
   f. 14
   g. 6
   h. 7
   i. 1
   j. 10

2. a. 3
   b. 4
   c. 1
   d. 2
   e. 5

3. a. 4
   b. 3
   c. 1
   d. 5

4. a. Slab poured monolithic
   b. Spread footing

5. a. Header
   b. Sill
   c. Joist

6. a. Header
   b. Double plate
   c. Top plate
   d. Stud
   e. Bottom plate

7. a. Bottom chord
   b. Gusset
   c. Top chord

8. a. Fascia
   b. Sheathing
   c. Footing
   d. Rafter
   e. Ceiling joist
   f. Floor joist

## ANSWERS TO TEST

| | | |
|---|---|---|
| 9. | a. | 2 |
| | b. | 1 |
| | c. | 3 |

| | | | | |
|---|---|---|---|---|
| 10. | a. | HT | f. | HE |
| | b. | HE | g. | LE |
| | c. | PT | h. | LE |
| | d. | HT | i. | HT |
| | e. | PT | j. | HE |

11. Any three of the following:

    a. Do not drop tools.
    b. Keep tools clean.
    c. Keep tools sharp.
    d. Return tools to storage cabinet after use.
    e. Keep tools dry and oiled.
    f. Use tools only for their intended purposes.

| | | | | |
|---|---|---|---|---|
| 12. | a. | F | d. | T |
| | b. | T | e. | F |
| | c. | T | f. | F |

| | | | | |
|---|---|---|---|---|
| 13. | a. | F | d. | F |
| | b. | T | e. | F |
| | c. | T | f. | T |

14.-15. Evaluated to the satisfaction of the instructor

# FINISHING A STRUCTURE
## UNIT C-4

## UNIT OBJECTIVE

After completion of this unit, the student should be able to participate as a team member in finishing the structure. Competencies will be demonstrated by completing the lab activity sheets and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to finishing a structure with the correct definitions.
2. List steps in finishing a structure.
3. Select purposes of finish work.
4. Complete statements concerning exterior finishing.
5. Identify types of insulation used in a structure.
6. Complete statements concerning interior finishing.
7. List parts of mechanical systems installed as finish work.
8. Match steps in landscaping with the correct descriptions.
9. List ways to conserve energy in construction.
10. Finish the garden/utility shed. (Lab Activity Sheet #1)
11. Inspect the garden/utility shed. (Lab Activity Sheet #2)

# FINISHING A STRUCTURE
## UNIT C-4

## SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher edition only and are designed to be used with the following objectives:

TM 1 — Exterior Finishing — Objective 4
TM 2 — Interior Finishing — Objective 6

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information sheet.

F. Discuss information sheet.

G. Provide students with lab activity sheets.

H. Discuss and demonstrate the procedures outlined in the lab activity sheets.

I. Integrate the following activities throughout the teaching of this unit:

1. Use Teacher Supplement #1 to present AIT video C-4. This video was developed by the Agency for Instructional Technology (AIT) and a consortium of states to accompany this publication. Contact your state supervisor of technology education for copies, or contact AIT directly for more information:

   Agency for Instructional Technology (AIT)
   Box A, Bloomington, IN 47402
   800-457-4509 or 812-339-2203

2. Use Teacher Supplement #2 to help students understand this unit's terminology. Make copies (fronts only) for your students. The answers are on the back of the supplement.

3. Take pictures or videotapes of local buildings which show different types of exterior materials, especially roofing materials and exterior wall finishes.

4. Show actual samples of exterior materials.

5. Demonstrate how to apply caulking and install weatherstripping. Students may wish to caulk and weatherstrip their homes.

6. Show samples of insulation materials and discuss their R-values.

## SUGGESTED ACTIVITIES

7. Take pictures or videotapes of interior walls, ceilings, floors, trim, and cabinets which show different types of materials used.

   (NOTE: Pictures suggested in 3 and 7 should be displayed on a bulletin board. You may prefer to have students take these pictures and then design the bulletin board.)

8. Show actual samples of interior materials such as wallpaper pieces, flooring samples, and trim boards.

9. Show brochures of new mechanical system fixtures.

10. Have students landscape a local site. This could be a local business, city park, or school property. Contact proper authorities before beginning. This could be used to raise money for a student organization or as a community service.

11. Discuss types of solar energy systems and how they can be used to conserve energy.

12. Discuss future trends in construction. Discuss new products and procedures that you think will happen.

13. Discuss careers involved in finish work.

14. Discuss the use of advanced technology in the design and building of the "Smart House" research project. Contact the following for information:

    National Association of Home Builders Research Foundation
    P.O. Box 1627
    Rockville, MD 20850
    301-762-4200

15. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

J. Administer test.

K. Evaluate test.

L. Reteach if necessary.

## RESOURCES USED IN DEVELOPING THIS UNIT

A. Bame, E. Allen and Paul Cummings. *Exploring Technology.* Worcester, MA: Davis Publications, 1980.

B. Fales, James F., et. al. *Technology Today and Tomorrow.* Mission Hills, CA: Glencoe/McGraw-Hill, 1988.

## SUGGESTED ACTIVITIES

C. Feirer, John L. and John R. Lindbeck. *Production Technology*. Mission Hills, CA: Glencoe/McGraw-Hill, 1985.

D. Hendrix, Laborn J. "Bud". *Residential Carpentry*. Stillwater, OK: Oklahoma State Board of Vocational and Technical Education, 1985.

E. Landers, Jack M. *Construction: Materials, Methods, Careers*. South Holland, IL: Goodheart-Willcox Company, Inc., 1983.

F. Lux, Donald G., et. al. *World of Construction*. Mission Hills, CA: Glencoe/McGraw-Hill, 1988.

G. Williams, Charles F., et. al. *Technology for Tomorrow*. Cincinnati, OH: South-Western Publishing Company, 1985.

H. Wright, R. Thomas and Howard Bud Smith. *Understanding Technology*. South Holland, IL: Goodheart-Willcox Company, Inc., 1989.

## SUGGESTED SUPPLEMENTAL RESOURCES

A. *Solar Energy: Hope for the Future*, VHS video program #5-4539. Available from:

Vocational Media
Box 1050
Mt. Kisco, NY 10549
800-431-2266

B. *Construction Systems Technology: Finishing the Structure*, video

C. *Gypsum Board Installation and Finishing*, video

B and C are available from:

Bergwall Productions, Inc.
P.O. Box 238
Garden City, NY 11530-0238
800-645-3565

D. *Finishing a Structure*, 14 min. Available from:

Agency for Instructional Technology
Box A
Bloomington, IN 47402
800-457-4509

E. *Drywall*, #8308

F. *Decorating with Carpet*, #8321

G. *Hardwood*, #8322

## SUGGESTED ACTIVITIES

H. *Vinyl Floors*, #8323

I. *Energy Conservation*, #7203

J. *Exterior Projects*, #7208

K. *Interior Paint and Wallpaper*, #7213

L. *Paneling*, #7215

M. *Ceilings*, #7220

E - M are available from:

Hearlihy and Company
714 W. Columbia
P.O. Box 869
Springfield, OH 45501
800-622-1000

# FINISHING A STRUCTURE
## UNIT C-4

## TEACHER SUPPLEMENT #1 — USING AIT VIDEO C-4

### Introduction and Program Summary (13:33)

This program introduces the process of finishing a structure inside and out and the three subsystems (heating/cooling, plumbing, and electrical) that are installed at this time. It opens showing a school under construction and the need for exterior and interior finishing before the building can be used. Rooms of the school under construction are contrasted with the same rooms six months later when they have been finished with insulation, soundproofing, glass, wall finishes, flooring, ceilings, lights, water, and heating. Finishing is described in terms of the systems model, in which people, materials, and energy provide the input that undergoes the finishing process to result in a finished room; the feedback is the teachers' enthusiasm about their new building.

Footage shows the "house of the future," as it was imagined 30 years ago. Then viewers see the "Smart House," designed by engineers today for maximum energy efficiency and control. A single cable feeds the electrical systems, telephone, and stereo. Gas lines for heating, cooling, and cooking are controlled by computer modules. Safety is built into the electrical and gas systems. Residents get constant feedback about appliances' energy usage and cost. They can control the systems by calling in on their telephones. In the future, computers will be used increasingly for planning, design, and control of subsystems. Viewers are asked how such computerized systems will save builders' time and money.

### Video Program Objectives

The video program will illustrate

- a structure's subsystems: heating/cooling, plumbing, and electrical
- the steps and materials used to finish a structure
- how new technologies are improving the efficiency of subsystems

### Before the Program

1. Tell your students they will see a program on finishing structures inside and out and the three main subsystems—heating and cooling, plumbing, and electrical.
2. Ask students, "What does it mean to 'finish' a house?" After they suggest answers, tell them that they will learn more in the video program.
3. Ask your students if they have ever had the electricity, water, or heating fail? Remind them that people 100 years ago and many today do not have these. Ask whether these are important and desirable.
4. Tell students what they will be doing in the lab, and how the content of the video program will set the stage for the laboratory activity.

## TEACHER SUPPLEMENT #1

5. Tell students to note the following in the video program; interior and exterior finishing; purpose of finishing; description of the subsystems; finishing of the school; characteristics of the "Smart House."

6. Tell students to listen for the following terms. (You might write them on the chalkboard.)

    exterior finishing
    heating and cooling
    duct work
    control
    insulation
    interior finishing
    electrical subsystem
    forced-air furnace
    geothermal
    fire rating
    subsystems
    plumbing subsystem
    closed-loop system
    electric meter
    "Smart House"

### After the Program: Questions for Discussion and Review

1. What is meant by "finishing" a house and why do we do it? *(applying materials to the inside and outside surfaces and installing subsystems to improve appearance, protect surfaces, make the house more comfortable, and improve energy efficiency)*

2. What materials are used in exterior finishing? Interior finishing? *(**exterior**—wood shingles, composite roofing, vinyl or aluminum siding, or masonry; **interior**—wallboard or "sheetrock," paint, wallpaper, paneling, and floorings—hardwood, tile, carpet, or vinyl)*

3. Why was fiberglass insulation used in the walls of the school? *(insulation of sound, conservation in heating and cooling, and for fire safety)*

4. Describe three kinds of subsystems. *(**heating and cooling**—ductwork, furnace and/or air-conditioner, and thermostat; **plumbing**—supplies water to the house and removes used water and liquid waste; **electrical**—supplies electrical energy to the house for lighting and to power appliances used for recreation, personal care, and food preparation)*

5. Describe the finishing of the school in terms of the universal systems model (input, process, output, feedback). (***input**—people, materials, energy; **process**—installation of finishing materials and subsystems using various construction processes; **output**—the finished school; **feedback**—the response of the students and teachers to the new school)*

6. What were the changes in the school's rooms before and after finishing? *(**cafeteria**—painted walls, tiled floors, windows, light; **gymnasium**—wood floor, bleachers, lights; **hallways**—carpeted floor, handrails, lockers, lights; **swimming pool**—painted bottom with stripes, finished pool deck area, lighting)*

7. Describe features of the "Smart House." *(All the wiring is in one cable instead of separate lines. All systems are controlled by computers. A closed-loop system for electricity delivers only when an appliance requires it. Lighting and heating are controlled by telephone calls. In case of fire, gas automatically shuts off and the fire department is called. Computer controls make the house more energy-efficient and convenient.)* How do today's homes differ from the 1950s "Home of the Future?" *(Today we have personal microcomputers, microwave ovens, and are using solar and energy-efficient devices.)*

## TEACHER SUPPLEMENT #1

8. In houses today, more plastics are used to conserve wood, and more insulation is being used to save energy. In the future, what other resources should we try to conserve? *(student discussion)*

ETE-139-C

# FINISHING A STRUCTURE
## UNIT C-4

## TEACHER SUPPLEMENT #2 — CROSSWORD PUZZLE

Name ______________________________ Date __________ __________

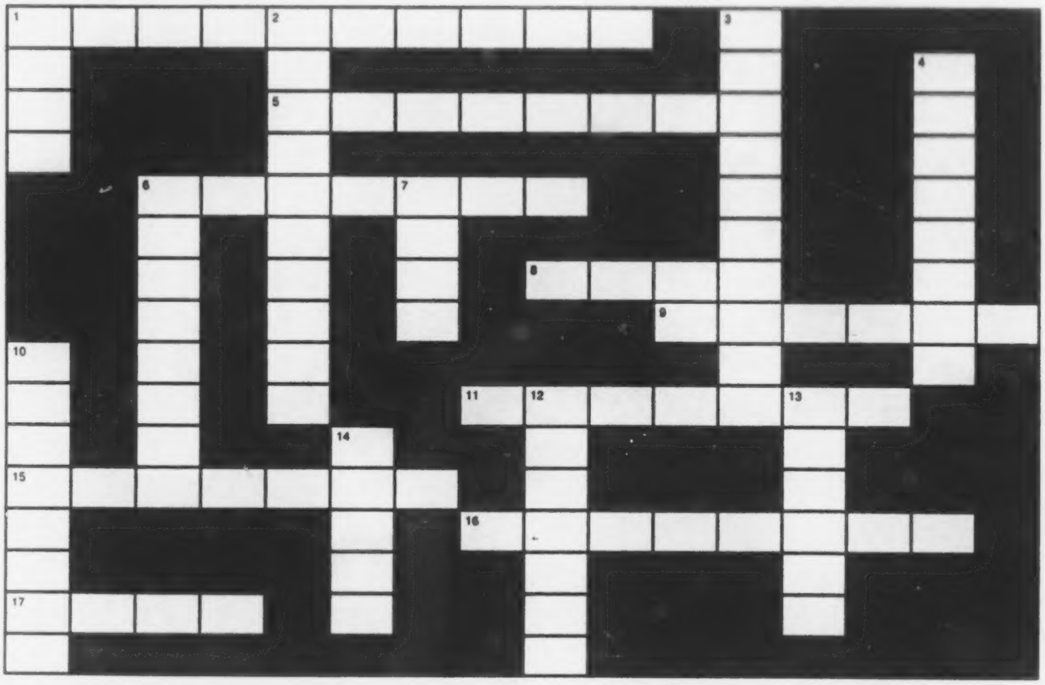
Directions: Use the clues below to solve the crossword puzzle.

ACROSS

1. Automatic device for controlling temperature
5. Wood cases or cupboards usually having doors and shelves for storage
6. ________ stripping used to keep out rain, snow, or cold air
8. Type of insulation
9. Boards or metal pieces covering the outside walls
11. Stonework or brickwork
15. Any rigid sheathing material applied to interior walls and ceilings
16. Small, thin pieces laid in overlapping rows as a roof covering
17. Upper part of building that must be covered and finished

DOWN

1. Light woodwork used to finish openings and for decoration
2. Electric, plumbing, and HVAC
3. Materials used to inhibit the passage of heat, cold, and sound
4. Waterproofing compound used to seal seams, cracks, or joints
6. Document that guarantees product performance
7. Furnaces provide ______________
10. Metal items such as fittings and locks
12. Type of shingle
13. Measure of resistance to heat flow
14. May be finished with carpeting



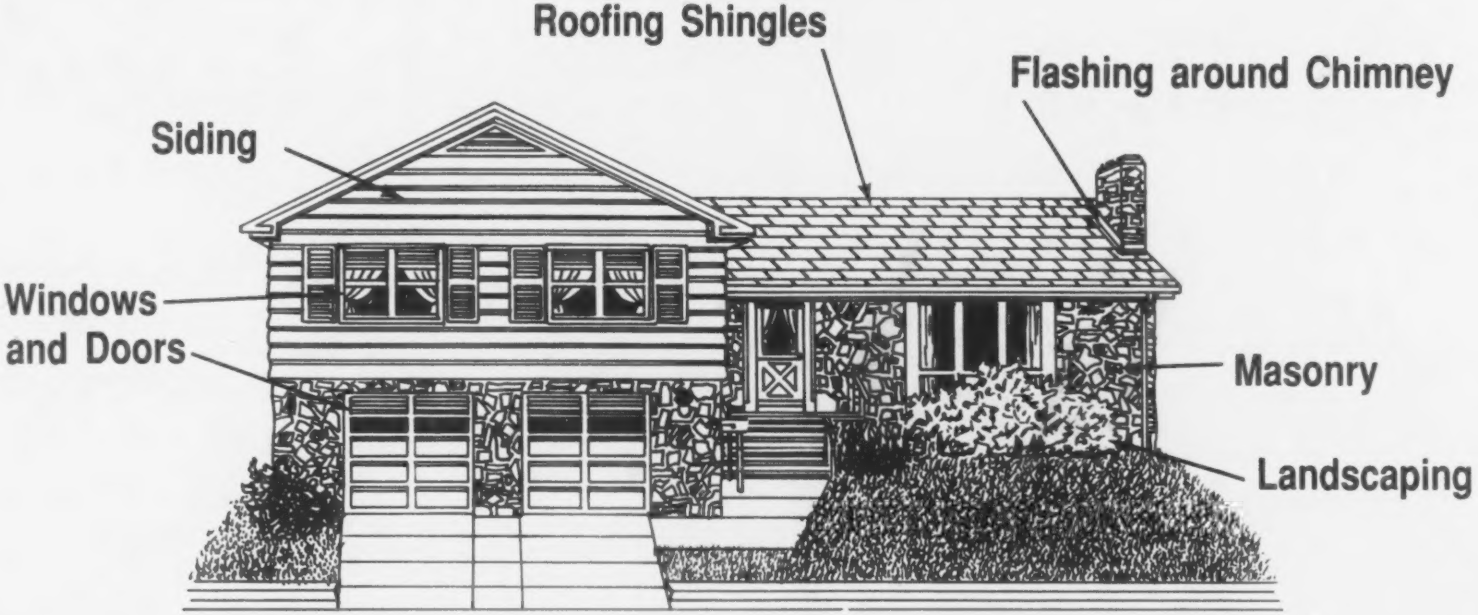
*Duplication Permitted*

## TEACHER SUPPLEMENT #2

## CROSSWORD PUZZLE ANSWER KEY

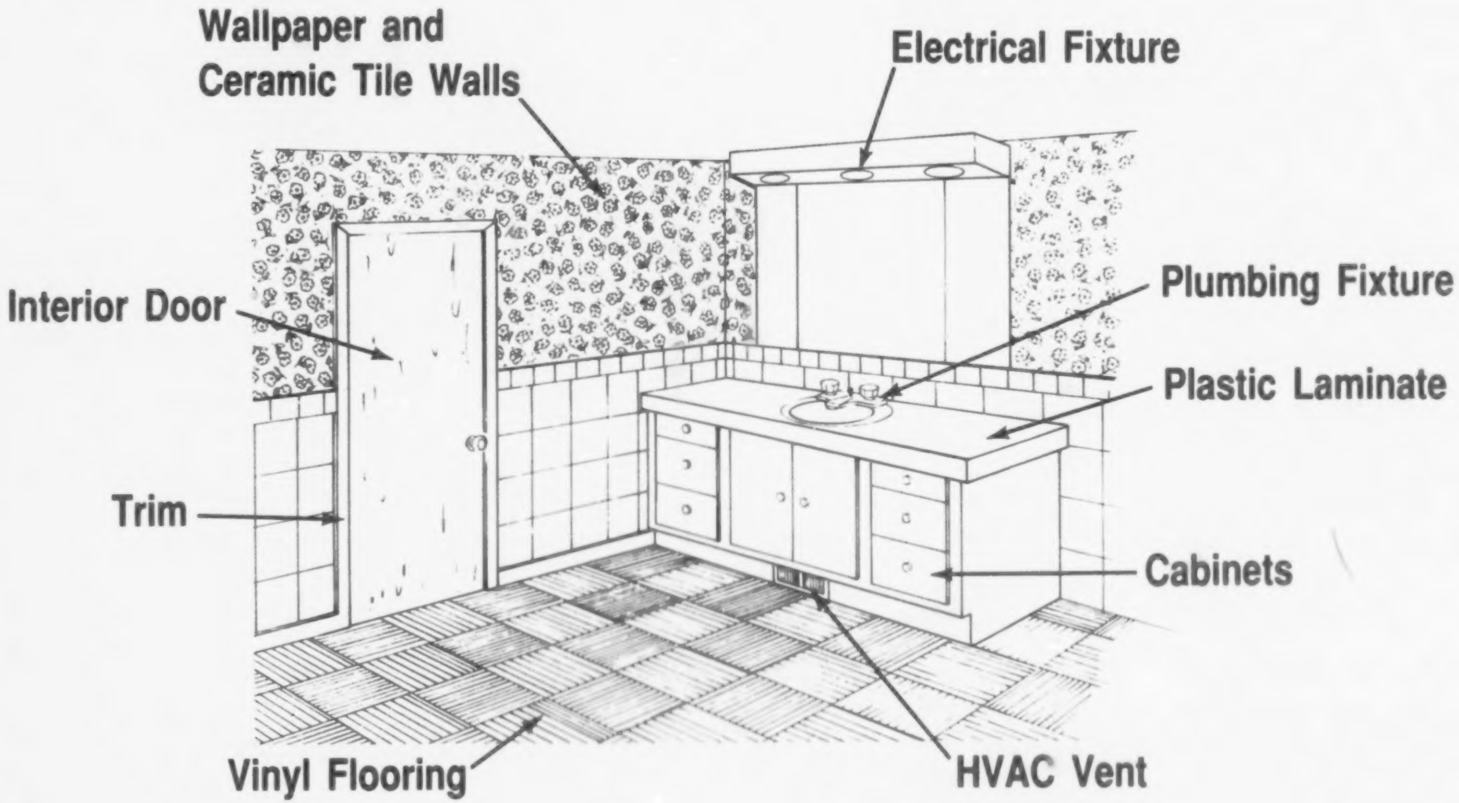
| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 T | H | E | R | 2 M | O | S | T | A | T | | 3 I | | | | |
| R | | | | E | | | | | | | N | | | 4 C | |
| I | | | | 5 C | A | B | I | N | E | T | S | | | A | |
| M | | | | H | | | | | | | U | | | U | |
| | | 6 W | E | A | T | 7 H | E | R | | | L | | | L | |
| | | A | | N | | E | | | | | A | | | K | |
| | | R | | I | | A | | 8 B | A | T | T | | | I | |
| | | R | | C | | T | | | | 9 S | I | D | I | N | G |
| 10 H | | A | | A | | | | | | | O | | | G | |
| A | | N | | L | | | 11 M | 12 A | S | O | N | 13 R | Y | | |
| R | | T | | | 14 F | | | S | | | | V | | | |
| 15 D | R | Y | W | A | L | L | | P | | | | A | | | |
| W | | | | | O | | 16 S | H | I | N | G | L | E | S | |
| A | | | | | O | | | A | | | | U | | | |
| 17 R | O | O | F | | R | | | L | | | | E | | | |
| E | | | | | | | | T | | | | | | | |

# Exterior Finishing


Roofing Shingles
Flashing around Chimney
Siding
Windows and Doors
Masonry
Landscaping

373

# Interior Finishing


Wallpaper and Ceramic Tile Walls
Electrical Fixture
Interior Door
Plumbing Fixture
Plastic Laminate
Trim
Cabinets
Vinyl Flooring
HVAC Vent

# FINISHING A STRUCTURE
## UNIT C-4

## INFORMATION SHEET

I. **Terms and definitions**

A. Cabinets — Wood cases or cupboards usually having doors and shelves for storage

B. Caulking — Waterproofing compound used to seal seams, cracks, or joints

C. Drywall — Any rigid sheathing material applied to interior finish walls and ceilings

(NOTE: This may also be referred to as gypsum wallboard, plasterboard, or sheetrock.)

D. Fixtures — Something attached to a building to serve a mechanical system

Examples: Lighting unit, sink, toilet

E. Flashing — Sheet metal used in waterproofing roof valleys and openings

F. Hardware — Items manufactured from metals such as fittings, locks, hinges, and door knobs

G. Insulation — Material used to inhibit the passage of heat, cold, and sound; most commonly used in walls, ceilings, floors, and often wrapped around pipes

H. Landscaping — Modifying natural land forms primarily by changing the plant cover

I. Masonry — Stonework or brickwork laid with mortar

J. Mechanical systems — Electrical, plumbing, and heating, ventilating, and air conditioning (HVAC) systems that support a structure

K. R-value — Measure of resistance to heat flow

(NOTE: Higher numbers indicate better insulating properties.)

L. Shingles — Small, thin pieces of building materials laid in overlapping rows as a roof or wall covering

M. Siding — Boards or metal pieces covering the outside walls of frame buildings

N. Thermostat — Automatic device for controlling temperature

O. Trim — Light woodwork used to finish openings and for decoration

P. Warranty — A document that states the period of time in which the builder or supplier guarantees that the product will perform properly

## INFORMATION SHEET

Q. Weatherstripping — Strip of material around a door or window to keep out rain, snow, or cold air

II. **Steps in finishing a structure (building)**

(NOTE: Many of these jobs will be done by subcontractors. Because several subcontractors may be working at once, several steps may be happening at once.)

A. Finish exterior.

B. Install insulation.

C. Finish interior.

D. Complete mechanical systems.

E. Landscape grounds.

F. Inspect structure and make required repairs.

G. Legally transfer structure to owner.

III. **Purposes of finish work**

A. To improve appearance

Examples: Plumbing pipes, heating ductwork, and electrical wires are covered with drywall and paint so they will not show. Landscaping makes a site look "finished."

B. To protect structure from nature and intruders

Examples: Roofing materials and exterior siding must withstand adverse weather. Doors and windows control access to the building.

C. To make structure more comfortable and usable

Examples: Mechanical systems are used to control climates, provide electricity, and fresh water. Carpeting is used because it absorbs noise and is more pleasant to walk on. Cabinets are installed for storage.

D. To improve energy efficiency

Example: Insulation is added to control heat loss and gain and therefore reduce energy bills.

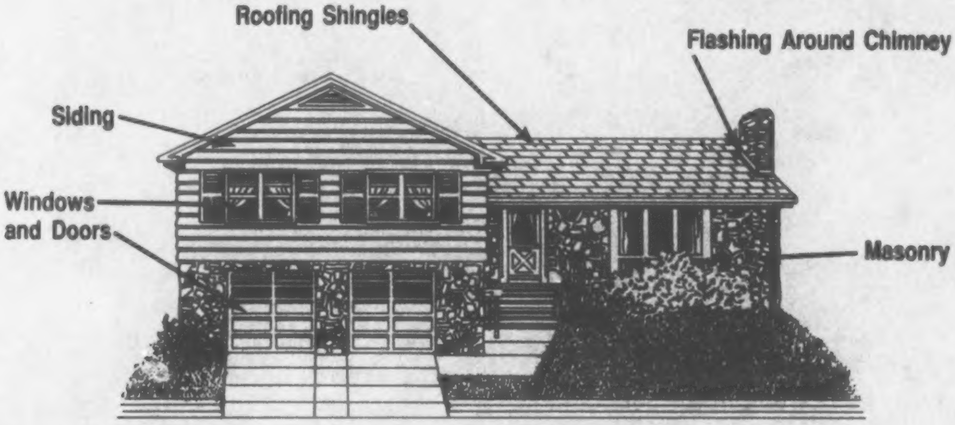
## INFORMATION SHEET

### IV. Items requiring exterior finishing

A. Roof is usually finished with wood, asphalt, or composition shingles and flashing at joints and openings in the roof such as for chimney.

(NOTE: Many other types of roofing materials can be used, especially for commercial buildings.)

B. Exterior walls are covered with masonry or siding. Siding and/or trim is then painted, stained, or sealed.



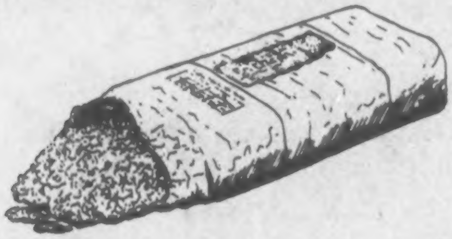
C. Windows and exterior doors are installed and trimmed. Hardware is added. Windows and doors are then painted or stained.

D. Electrical outlets and light fixtures are installed.

E. Caulking and weatherstripping are used to seal the structure from energy loss.

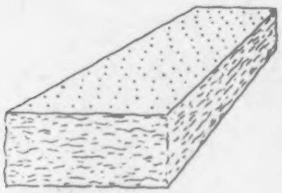
### V. Types of insulation used in a structure

A. Loose fill — Poured or blown in

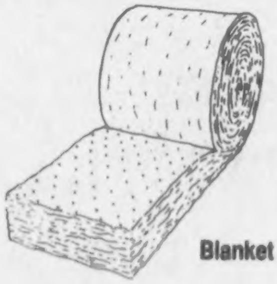


## INFORMATION SHEET

B. Batts and blankets — Flexible material sized to fit between framing members; may have a paper or reflective backing

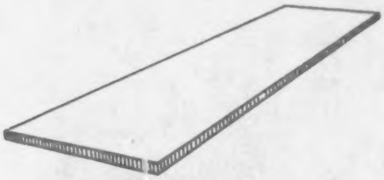


**Batt**

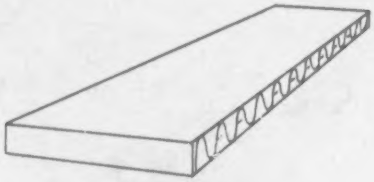


**Blanket**

C. Rigid boards — Nailed to framing members; made of various materials



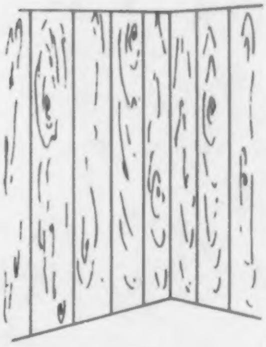
**Wood Fiber Board**



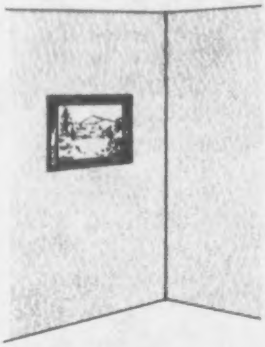
**Plastic Foam Board**

VI. **Items requiring interior finishing**

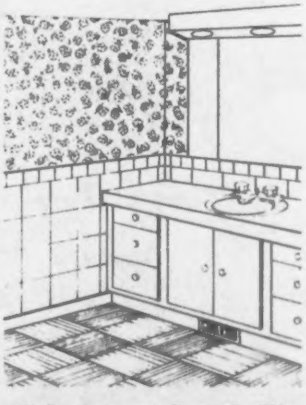
A. Walls — Paneling or drywall is usually attached to framing. Drywall may then be textured and painted, wallpapered, or tiled.



**Paneling**



**Painted and Textured Drywall**



**Wallpaper and Ceramic Tile**

## INFORMATION SHEET

B. Ceilings — Usually are finished with drywall, texturing, and paint or may have suspended acoustical tiles. Exposed beams may also be used.

C. Interior doors — Are installed with hardware and are then painted or stained.

D. Trim — Doors and windows are trimmed to finish seams. Molding and baseboards may also be added to the edges of floors and ceilings. Trim is then painted or stained.

E. Cabinets — Are custom built or are modular units built in a shop or factory. Either type must be installed and painted or stained and sealed. Plastic laminate (such as Formica®) may be glued to the tops of heavily used cabinets.

F. Floors — Are covered with carpeting, vinyl flooring, masonry products such as ceramic tile or brick, or hardwood which must also be sanded and sealed.

**VII. Parts of mechanical systems installed as finish work**

A. Plumbing — Plumbing fixtures such as toilets, sinks, bathtubs, and showers as well as water heaters

B. Electrical — Lighting fixtures, electrical outlets (receptacles), switches, and electrical appliances

C. Climate control — Heating and air conditioning units, thermostats, registers, and vents

**VIII. Steps in landscaping**

A. Earthwork — Involves replacing and shaping the earth surrounding the construction site to improve drainage and enrich soil so plants will grow

B. Building accesses — Constructing driveways, parking areas, walkways, and decks and railings

C. Planting — Consists of preparing the soil and planting shrubs, trees, grass, and flowering plants

D. Cleaning — Picking up and disposing of all debris such as empty bottles, cans, boxes, and construction scraps

## INFORMATION SHEET

### IX. Ways to conserve energy in construction

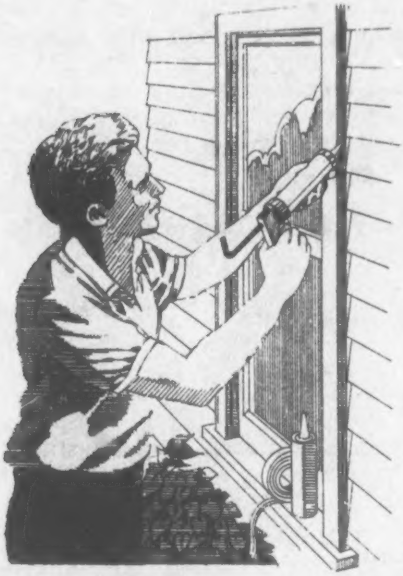
A. Insulate ceilings, floors, and walls, especially exterior walls, to the R-value recommended.

B. Ventilate attics with vents in soffit and vent in ridge.

C. Use energy-efficient, insulated doors and multipaned, insulated windows.

(NOTE: Many new windows are specially treated to reflect solar heat.)

D. Make sure doors and windows fit tightly and are properly caulked and weather-stripped.



E. Add storm doors and storm windows to reduce air infiltration.

F. Insulate and locate heating ducts and hot water pipes away from exterior walls if possible.

G. Use energy-efficient appliances and heating and cooling units that are properly sized for the structure.

H. Use solar energy to heat the structure when possible.

I. Protect north walls (especially in cooler climates) by using fewer windows and doors on that side and by using evergreen trees and shrubs to break cold winds.

J. Protect west walls (especially in warmer climates) by using fewer windows and doors on that side and by planting trees to provide shade from the sun's heat.

## FINISHING A STRUCTURE
## UNIT C-4

### LAB ACTIVITY SHEET #1 —FINISH THE GARDEN/UTILITY SHED

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Jobs are completed appropriately | ______ |
| Information listed is correct and complete | ______ |

(NOTE: The finishing procedure should be in accordance with the project constructed in Unit C-3.)

A. Tools and materials — As required for construction

B. Procedure

1. Finish exterior. List the jobs required.

   ______________________________________________

   ______________________________________________

   ______________________________________________

   ______________________________________________

2. Install insulation. Name the type used ______________________

   and where it is used ______________________________

   ______________________________________________

3. Finish interior. List the jobs required.

   ______________________________________________

   ______________________________________________

   ______________________________________________

   ______________________________________________

   ______________________________________________

## LAB ACTIVITY SHEET #1

4. Complete mechanical systems. List the materials needed.

   (NOTE: Not all systems may be used.)

   a. Electrical — ______________________________

   ______________________________

   b. Plumbing — ______________________________

   ______________________________

   c. Climate control — ______________________________

   ______________________________

5. Landscape grounds if required.

6. Clean up site and store tools properly.

# FINISHING A STRUCTURE
## UNIT C-4

## LAB ACTIVITY SHEET #2 — INSPECT THE GARDEN/UTILITY SHED

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Steps are followed | ______ |
| Shed passes inspection | ______ |

(NOTE: The inspection procedure should be in accordance with the project constructed in Unit C-3 and Lab Activity Sheet #1 of this unit.)

A. Complete the following inspections by checking YES or NO. (Inspection tolerance is ± ½" on distance and ± 2 degrees on squareness.)

| | | YES | NO |
|---|---|---|---|
| 1. | Are the windows located at the location shown on the floor and elevation plan? | | |
| 2. | Was the door properly located according to the floor plan? | | |
| 3. | Is the shed the proper length? | | |
| 4. | Is the shed the proper width? | | |
| 5. | Are all four walls of the shed square with the floor? | | |
| 6. | Has the construction site been cleaned up? | | |
| 7. | Are all of the construction tools placed where they are supposed to be? | | |
| 8. | Are all four walls of the shed the proper height? | | |
| 9. | Is the pitch of the roof as specified according to the elevation plan? | | |
| 10. | Are the roof sides square? | | |
| 11. | Do the shingle rain gauges (grooves) line up properly? | | |
| 12. | Are there any cracks in the floor of the shed 1/8" or more? | | |
| 13. | Are there any cracks in the siding joints on the exterior walls 1/8" or more? | | |

## LAB ACTIVITY SHEET #2

| | | YES | NO |
|---|---|---|---|
| 14. | Are there any cracks in the wall covering joints on the interior walls 1/8" or more? | | |
| 15. | Are the miter joints on the door trim tight joints (no cracks)? | | |
| 16. | Are the miter joints on the window trim tight joints (no cracks)? | | |
| 17. | Does the door open/close properly? | | |
| 18. | Do the light switch and outlet covers properly cover the holes in the wall covering? | | |
| 19. | Has the exterior trim been installed properly? | | |
| 20. | Does the electrical system operate properly? | | |

B. Record the following information.

1. Number of questions answered with a YES? ____________________
2. Number of questions answered with a NO? ____________________
3. Divide the number of YES questions by 20 to determine your construction efficiency. Record answer. ____________________

C. Evaluation

1. How do you feel the shed turned out? ____________________

    ________________________________________

2. What part was the best? ____________________

    ____________________ Worst? ____________________

3. If you were to construct another shed, how would you do it differently? ____

    ________________________________________

    ________________________________________

    ________________________________________

## FINISHING A STRUCTURE
## UNIT C-4

## TEST

Name ______________________________ Score ____________________

1. Match the terms on the right with the correct definitions.

_____a. Measure of resistance to heat flow

_____b. Any rigid sheathing material applied to interior finish walls and ceilings

_____c. Automatic device for controlling temperature

_____d. Materials used to inhibit the passage of heat, cold, and sound; most commonly used in walls, ceilings, floors, and often wrapped around pipes

_____e. Strip of material around a door or window to keep out rain, snow, or cold air

_____f. Sheet metal used in waterproofing roof valleys and openings

_____g. Light woodwork used to finish openings and for decoration

_____h. Waterproofing compound used to seal seams, cracks, or joints

_____i. Small, thin pieces of building materials laid in overlapping rows as a roof or wall covering

_____j. Items manufactured from metals such as fittings, locks, hinges, door knobs

_____k. Modifying natural land forms primarily by changing the plant cover

1. Cabinets
2. Caulking
3. Drywall
4. Fixtures
5. Flashing
6. Hardware
7. Insulation
8. Landscaping
9. Masonry
10. Mechanical systems
11. R-value
12. Shingles
13. Siding
14. Thermostat
15. Trim
16. Warranty
17. Weatherstripping

## TEST

2. List five steps in finishing a structure (building).

   a. ____________________

   b. ____________________

   c. ____________________

   d. ____________________

   e. ____________________

3. Select from the following list the purposes of finish work by placing an "X" next to the correct purposes.

   ______a. To improve energy efficiency

   ______b. To lower construction costs

   ______c. To improve appearance

   ______d. To prepare site for construction

   ______e. To give structural support

   ______f. To make structure more comfortable and usable

   ______g. To protect structure from nature and intruders

4. Complete the following statements on items requiring exterior finishing by filling in the blanks with the correct words.

   a. The roof is usually finished with ____________________ and flashing.

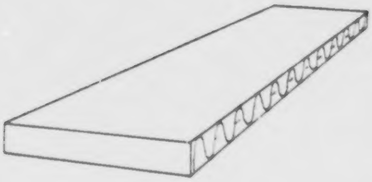
   b. Exterior walls are covered with ____________________ or ____________________.

   c. Windows and exterior doors are installed and trimmed. They are then ____________________ or stained.

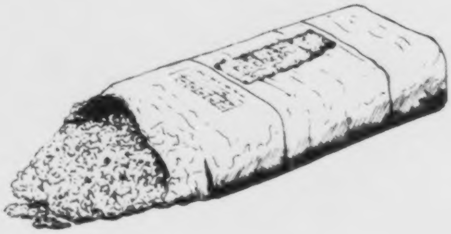
   d. ____________________ is used to seal the structure from energy loss.

## TEST

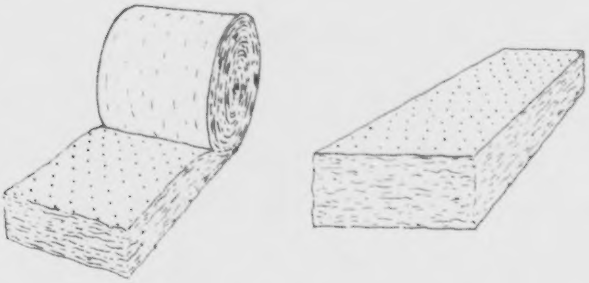
5. Identify the following types of insulation used in a structure.



a. ______________________



b. ______________________



c. ______________________

6. Complete the following statements on items requiring interior finishing by filling in the blanks with the correct words.

   a. Walls may be finished with ______________________.

   b. Doors and windows are ______________________ to finish their seams.

   c. ______________________ may be glued to tops of heavily used cabinets.

   d. Floors may be finished with ______________________

7. List parts of the following mechanical systems that are installed as finish work. (List at least one part for each.)

   a. Plumbing — ______________________

   b. Electrical — ______________________

   c. Climate control — ______________________

## TEST

8. Match the steps in landscaping with the correct descriptions.

______a. Constructing driveways, parking areas, walkways, decks

______b. Involves replacing and shaping earth on site to improve drainage and enrich soil

______c. Picking up and disposing of debris

1. Earthwork
2. Building accesses
3. Planting
4. Cleaning

9. List five ways to conserve energy in construction.

a. ______________________________

______________________________

b. ______________________________

______________________________

c. ______________________________

______________________________

d. ______________________________

______________________________

e. ______________________________

______________________________

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

10. Finish the garden/utility shed. (Lab Activity Sheet #1)

11. Inspect the garden/utility shed. (Lab Activity Sheet #2)

## FINISHING A STRUCTURE
## UNIT C-4

### ANSWERS TO TEST

1.
    a. 11
    b. 3
    c. 14
    d. 7
    e. 17
    f. 5
    g. 15
    h. 2
    i. 12
    j. 6
    k. 8

2. *Any five of the following*:

    a. Finish exterior.
    b. Install insulation
    c. Finish interior.
    d. Complete mechanical systems.
    e. Landscape grounds.
    f. Inspect structure and make required repairs.
    g. Legally transfer structure to owner.

3. a, c, f, g

4.
    a. Shingles
    b. Masonry, siding
    c. Painted
    d. *Either* caulking *or* weatherstripping

5.
    a. Rigid board (plastic foam shown)
    b. Loose fill
    c. Batt or blanket

6.
    a. *Either* paneling *or* drywall
    b. Trimmed
    c. Plastic laminate (Formica®)
    d. *Any one*: Carpeting, vinyl flooring, masonry, hardwood

7. *Any one for each of the following*:

    a. Plumbing — Fixtures such as toilets, sinks, bathtubs, or showers. Also water heaters
    b. Electrical — Lighting fixtures, electrical outlets, switches, or electrical appliances
    c. Climate control — HVAC units, thermostats, registers, or vents

## ANSWERS TO TEST

8. a. 2
   b. 1
   c. 4

9. *Any five of the following*:

   a. Insulate ceilings, floors, and walls, especially exterior walls, to the R-value recommended.
   b. Ventilate attics with vents in soffit and vent in ridge.
   c. Use energy-efficient, insulated doors and multipaned, insulated windows.
   d. Make sure doors and windows fit tightly and are properly caulked and weather-stripped.
   e. Add storm doors and storm windows to reduce air infiltration.
   f. Insulate and locate heating ducts and hot water pipes away from exterior walls if possible.
   g. Use energy-efficient appliances and heating and cooling units that are properly sized for the structure.
   h. Use solar energy to heat the structure when possible.
   i. Protect north walls (especially in cooler climates) by using fewer windows and doors on that side and by using evergreen trees and shrubs to break cold winds.
   j. Protect west walls (especially in warmer climates) by using fewer windows and doors on that side and by planting trees to provide shade from the sun's heat.

10.-11. Evaluated to the satisfaction of the instructor

# INTRODUCTION TO MANUFACTURING
## UNIT D-1

## UNIT OBJECTIVE

After completion of this unit, the student should be able to match the divisions of manufacturing with their functions and be able to organize a classroom manufacturing company. Competencies will be demonstrated by completing the assignment sheets, lab activity sheet, and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to manufacturing with the correct definitions.
2. Complete statements concerning a historical perspective of manufacturing.
3. Distinguish between the advantages and disadvantages of manufacturing.
4. Discuss the interrelationship between manufacturing and other technologies.
5. Categorize the parts of a manufacturing system model.
6. Match the divisions of a manufacturing organization with the correct functions.
7. Match manufacturing divisions with the correct job titles.
8. Research and write about an inventor or invention that contributed to the Industrial Revolution. (Assignment Sheet #1)
9. Describe societal needs that the manufacturing industry has addressed during the last two centuries. (Assignment Sheet #2)
10. Research a manufacturing technology career. (Assignment Sheet #3)
11. Organize a classroom manufacturing company. (Assignment Sheet #4)
12. Participate in an assembly-line activity. (Lab Activity Sheet #1)

## INTRODUCTION TO MANUFACTURING
## UNIT D-1

## SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher edition only and are designed to be used with the following objectives:

TM 1 — Historical Perspectives of Manufacturing — Objective 2

TM 2 — Manufacturing Divisions — Objectives 6 and 7

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. Use Teacher Supplement #1 to present AIT video D-1. This video was developed by the Agency for Instructional Technology (AIT) and a consortium of states to accompany this publication. Contact your state supervisor of technology education for copies, or contact AIT directly for more information:

   Agency for Instructional Technology (AIT)
   Box A, Bloomington, IN 47402
   800-457-4509 or 812-339-2203

2. Use Teacher Supplement #2 to help students understand this unit's terminology. Make copies (fronts only) for your students. The answers are on the back of the supplement.

3. Show films or videotapes dealing with manufacturing and careers. Possible films are listed under Suggested Supplemental Resources.

4. Discuss the importance of all curriculum areas when studying manufacturing. Provide examples whenever possible.

5. When identifying an organizational structure (Assignment Sheet #4), the management (manager, assistant manager, accountant, quality control engineer, and foreman) along with other students in class are to develop the organizational structure of the company. The management is to lead others through the activity.

## SUGGESTED ACTIVITIES

6. Whenever group activities are used, point out that personalities and individuals are not important. Ideas are important and their source should not be considered. You may want to institute a policy where ideas must be presented by individuals who did not originate the idea.

7. Take a field trip to a local manufacturing company.

8. Have a local manufacturing industry representative talk to your class about company or plant organization.

9. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Give test.

I. Evaluate test.

J. Reteach if necessary.

## ALTERNATE LABORATORY ACTIVITIES

A. Mass production of 20-30 inexpensive ball-point pens (click-type). Manufacturing contests between groups.

B. Assembly-line packaging of kits for the next term students.

Examples: Rocket parts, glider parts, mousetrap vehicle parts

C. Assemble photocopied booklets, worksheets, tests, etc., in an assembly-line fashion.

D. Assemble model dragster cars with their wheels, axles, screw eyes, washers, straws, decals, etc.

(NOTE: A conveyor belt table is very helpful in completing any assembly-line activities.)

## REFERENCES USED IN DEVELOPING THIS UNIT

A. Bame, E. Allen and Paul Cummings. *Exploring Technology*. Worcester, MA: Davis Publications, Inc., 1980.

B. *Manufacturing.* Stillwater, OK: Mid-America Vocational Curriculum Consortium, Inc.

C. Wright, R. Thomas and Len Sterry. *Industry and Technology Education: A Guide for Curriculum Designers, Implementors, and Teachers.* Lansing, IL: Technical Foundation of America.

## SUGGESTED ACTIVITIES

D. Wright, R. Thomas and Richard M. Henak. *Exploring Production*. South Holland, IL: Goodheart-Willcox Co., 1985.

E. Lux, D. G., and W. E. Ray. *The World of Manufacturing*. Bloomington, IL: McKnight and McKnight, 1971.

F. Komacek, Stanley, Ann E. Lawson, and Andrew C. Horton. *Manufacturing Technology*. Albany, NY: Delmar Publishers, Inc., 1990.

G. Fales, James F., et. al. *Manufacturing: A Basic Text*. Mission Hills, CA: Glencoe/McGraw-Hill, 1986.

H. Wright, R. Thomas. *Manufacturing: Material Processing, Management, Careers*. South Holland, IL: The Goodheart-Willcox Company, Inc., 1984.

I. Jambro, Donald J. *Introduction to Manufacturing*. Albany, NY: Delmar Publishers, Inc., 1982.

J. Hacker, Michael and Robert Barden. *Living with Technology*. Albany, NY: Delmar Publishers, Inc., 1988.

K. *Missouri Introduction to Materials and Processing Technology Guide*. Columbia, MO: IML (Instructional Materials Laboratory), University of MO - Columbia, 65202, 1989.

## SUGGESTED SUPPLEMENTAL RESOURCES

A. Films

1. *Modern Corporations*, 30 min. Available from:

   Sutherland Educational Films, Inc.
   201 North Occidental Boulevard
   Los Angeles, CA 90026

2. *Functions of Industry and You*, 15 min. Available from:

   University of Illinois
   Visual Aids Service
   Champaign, IL 61820

3. *Men Who Changed the World*, 11 min. Available from:

   University of Michigan
   Audio-Visual Education Center
   Ann Arbor, MI 48106

## SUGGESTED RESOURCES

B. Videotapes (VHS or Beta)

1. The following videotapes are available from:

   Morris Video
   413 Avenue G #1
   P.O. Box 443
   Redondo Beach, CA
   800-843-3603 or 213-379-2414

   a. *Management — Private Enterprise*, CS-201
   b. *Automobile Manufacturing*, CS-371
   c. *General Manufacturing*, CS-376

2. The following videotapes are available from:

   Modern Talking Picture Service
   500 Park Street North
   St. Petersburg, FL 33709-9989
   813-541-5763

   a. *Challenge of Manufacturing*, 26 min.
   b. *Inside Corporate America*, 28 min.
   c. *Race Against Time*, 29 min.
   d. *Automobile...Its First 100 Years*, 28 min. (A lot of footage is about the production of the automobile)
   e. *The Industrial Revolution*, a series of three tapes

3. The following videotapes are available from:

   Bergwall Productions, Inc.
   P.O. Box 238
   Garden City, NY 11530-0238
   800-645-3565

   a. *Manufacturing Systems Explained:*

      1) *Inputs and Resources I*, 21:41 min.
      2) *Inputs and Resources II*, 14:09 min.

   b. *Factory of the Future*, 4-video series

4. *Introduction to Manufacturing*, 15 min. Available from:

   Agency for Instructional Technology
   Box A
   Bloomington, IN 47402
   800-457-4509

## SUGGESTED ACTIVITIES

C. Manufacturing information

The following organizations will provide materials about manufacturing to educators:

1. American Society of Mechanical Engineers
   United Engineering Center
   345 E. 47th Street
   New York, NY 10017

2. JETS, Inc.
   Junior Engineering and Technology Society
   1420 King Street, Suite 405
   Alexandria, VA 22314

3. Society of Manufacturing Engineers
   P.O. Box 930
   One SME Drive
   Dearborn, MI 48121
   313-271-1500

4. Society of the Plastics Industry
   1275 K Street, N.W. Suite 400
   Washington, D.C. 20005

# INTRODUCTION TO MANUFACTURING
## UNIT D-1

## TEACHER SUPPLEMENT #1—USING AIT VIDEO D-1

### Introduction and Program Summary (15:11)

This program introduces manufacturing technology—its system components, devices, technological advances, and relationship to other technology systems. It focuses on the impact manufacturing technology has made on people as it produces goods that meet their needs and wants.

Defining manufacturing as changing materials into usable products in a workshop or factory, the program opens with a survey of manufacturing in the past. Dramatic re-creations and archival footage show the primitive creation of flint tools, weaving for domestic use and occasional barter, making shoes in a mercantile society, then Henry Ford and the development of the assembly line and use of standardized parts. The program analyzes the manufacture of Model T Fords in terms of the universal systems model, and describes how the development of such manufacturing brought about massive urban migration and the growth of cities.

The second revolution in manufacturing came with the introduction of robotics, resulting in less boring and dangerous work, but also in fewer unskilled jobs. Manufacturing has created many other jobs, however, including those in advertising, shipping, sales, and construction. It has also brought about environmental problems such as air pollution, toxic chemical waste, and chlorofluorocarbons. Viewers see the Disctronics plant in Huntsville, Alabama, where compact discs are made under tight conditions of purity and quality control. The worker responsible for checking the quality of the master tapes is profiled, and compact disc manufacturing is also analyzed in terms of the systems model. In the future, manufacturing may occur in space, which is pure and gravity-free.

### Video Program Objectives

The video program will illustrate

- the historical development, current status, and future possibilities of manufacturing technology
- the impact of manufacturing technology on society and the environment
- how the systems model applies to manufacturing (input, process, output, with a feedback loop)

### Before the Program

1. Tell your students this lesson introduces manufacturing technology and its importance to us. Progress in manufacturing technology lets us produce goods more efficiently. Point to various items, and say that these and every other product in this room was manufactured. What makes them manufactured items? What do they have in common? What would it be like if our "manufacturing technology" had not changed from the dawn of time?

## TEACHER SUPPLEMENT #1

2. Tell students what they will be doing in the lab, and how the content of the video program will set the stage for the laboratory activity.

3. Tell students to note the following in the video program: the definition of manufacturing; the systems model as it relates to examples of manufacturing technology; major historical and recent developments in manufacturing; the people responsible and their contributions; the connections between manufacturing systems and other technologies; examples of manufacturing systems.

4. Tell students to listen for the following terms and names. (You might write them on the chalkboard.)

barter system
merchant
Industrial Revolution
assembly line
Eli Whitney
robots
mercantile system
products
parts
Henry Ford
standardization
CFCs (chlorofluorocarbons)
ozone
factory

### After the Program: Questions for Discussion and Review

1. What is manufacturing? *(changing materials into usable products in a workshop or factory)*

2. What was one of the earliest examples of manufacturing? *(handmade weapons for protection and hunting)*

3. Describe some of the major developments that occurred in manufacturing technology. *(First, people began manufacturing products for their own use. Then, some exchanged goods or services with others through the barter system. Next, people began to specialize in their craft and made enough goods to sell them for a profit; the mercantile system began when a merchant bought from the craftsman and sold to others. The Industrial Revolution led to factories, the assembly line, interchangeability of parts, and the mass production of products. These developments led to the concentration of people in cities. Recent developments include robotics and the possibility of manufacturing in orbiting space factories.)*

4. In general, how has manufacturing technology changed? (Work is *cleaner, and there is less physical labor and drudgery. More unskilled work is being done by robots, so there are fewer jobs available for unskilled workers. Machines today are more capable of higher productivity and quality.)*

5. In the video program, what products were being manufactured? *(*$CO_2$ *cars, automobiles, compact discs, chocolate bars, pinball machines, tennis shoes)*

6. How do the terms of the universal systems model—input, process, output, and feedback—describe the manufacture of a car? *(**input:** people, money, energy, material; **process:** assembly line manufacturing process; **output**: finished car; **feedback:** popularity, many sales)*

## TEACHER SUPPLEMENT #1

7. What would it be like if each family had to manufacture everything it used? Ask about equipment to cook; clothing; means of heating a house; transportation; communication; and entertainment. *(student discussion)*

8. What will manufacturing technology be like in the future and how will it affect us? *(More restrictions for environmental reasons? Fewer low-skilled jobs? Intelligent androids in the factory? Student responses and discussion.)*

## INTRODUCTION TO MANUFACTURING
## UNIT D-1

### TEACHER SUPPLEMENT #2—SUPER WORD SEARCH

Name ______________________________ Date ____________________

Directions: Write the words that match the clues in the blank spaces, then find and circle the words in the puzzle.

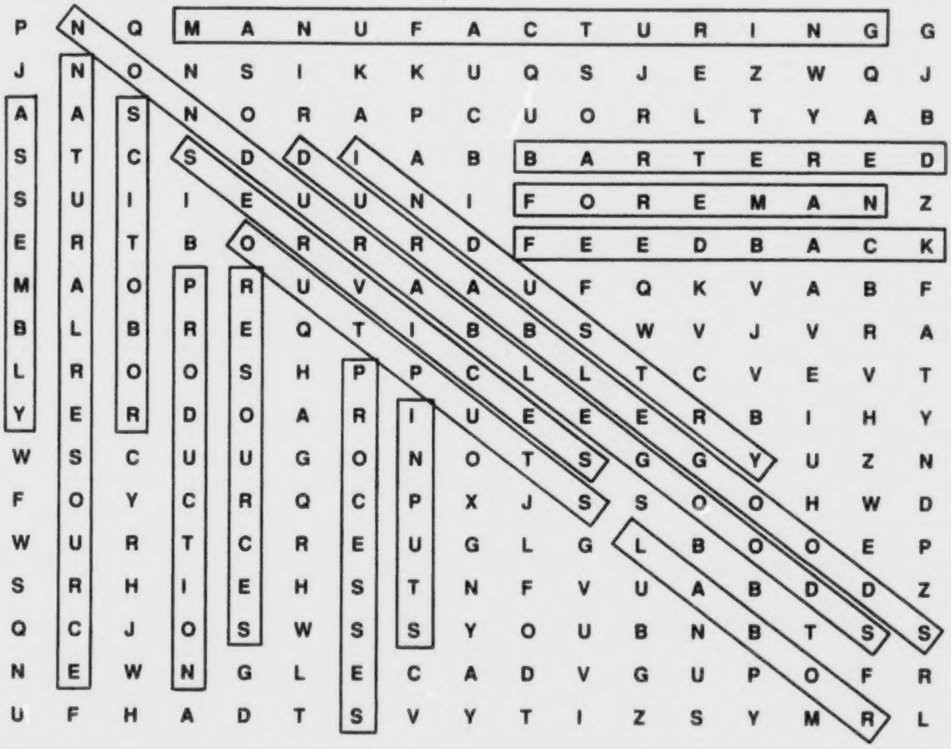
The area of manufacturing that makes a product ____________________
Items needed to manufacture a product ____________________
Work performed to improve material goods ____________________
The fitting together of parts to produce goods ____________________
Services performed by workers ____________________
Source of wealth supplied by nature ____________________
Sold or traded ____________________
Management practices, production processes, etc. ____________________
Changing materials into usable products ____________________
Oversees a group of tasks within a corporation ____________________
Products that last at least three years ____________________
Organization that uses resources to produce goods ____________________
Products that usually last fewer than three years ____________________
Durable goods and nondurable goods ____________________
Natural resources, finance, capital, etc. ____________________
Automated machines used in manufacturing ____________________
Customer response, profit and loss, etc. ____________________

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P | N | Q | M | A | N | U | F | A | C | T | U | R | I | N | G | G |
| J | N | O | N | S | I | K | K | U | Q | S | J | E | Z | W | Q | J |
| A | A | S | N | O | R | A | P | C | U | O | R | L | T | Y | A | B |
| S | T | C | S | D | D | I | A | B | B | A | R | T | E | R | E | D |
| S | U | I | I | E | U | U | N | I | F | O | R | E | M | A | N | Z |
| E | R | T | B | O | R | R | R | D | F | E | E | D | B | A | C | K |
| M | A | O | P | R | U | V | A | A | U | F | Q | K | V | A | B | F |
| B | L | B | R | E | Q | T | I | B | B | S | W | V | J | V | R | A |
| L | R | O | O | S | H | P | P | C | L | L | T | C | V | E | V | T |
| Y | E | R | D | O | A | R | I | U | E | E | E | R | B | I | H | Y |
| W | S | C | U | U | G | O | N | O | T | S | G | G | Y | U | Z | N |
| F | O | Y | C | R | Q | C | P | X | J | S | S | O | O | H | W | D |
| W | U | R | T | C | R | E | U | G | L | G | L | B | O | O | E | P |
| S | R | H | I | E | H | S | T | N | F | V | U | A | B | D | D | Z |
| Q | C | J | O | S | W | S | S | Y | O | U | B | N | B | T | S | S |
| N | E | W | N | G | L | E | C | A | D | V | G | U | P | O | F | R |
| U | F | H | A | D | T | S | V | Y | T | I | Z | S | Y | M | R | L |

## TEACHER SUPPLEMENT #2

## SUPER WORD SEARCH ANSWER KEY

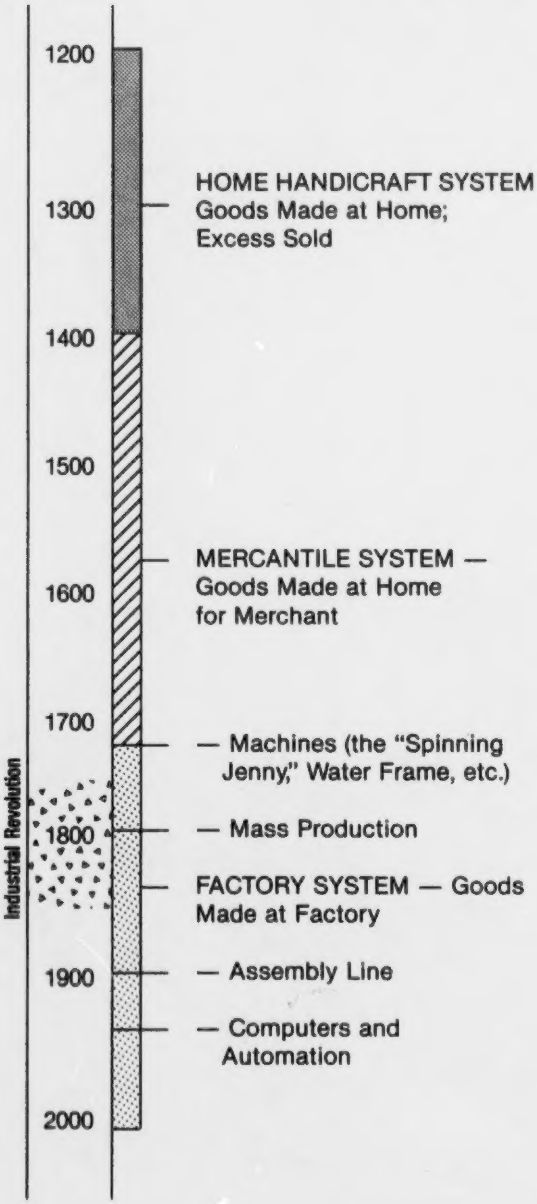
| | |
|---|---|
| The area of manufacturing that makes a product | PRODUCTION |
| Items needed to manufacture a product | RESOURCES |
| Work performed to improve material goods | SERVICES |
| The fitting together of parts to produce goods | ASSEMBLY |
| Services performed by workers | LABOR |
| Source of wealth supplied by nature | NATURAL RESOURCE |
| Sold or traded | BARTERED |
| Management practices, production processes, etc. | PROCESSES |
| Changing materials into usable products | MANUFACTURING |
| Oversees a group of tasks within a corporation | FOREMAN |
| Products that last at least three years | DURABLE GOODS |
| Organization that uses resources to produce goods | INDUSTRY |
| Products that usually last fewer than three years | NONDURABLE GOODS |
| Durable goods and nondurable goods | OUTPUTS |
| Natural resources, finance, capital, etc. | INPUTS |
| Automated machines used in manufacturing | ROBOTICS |
| Customer response, profit and loss, etc. | FEEDBACK |



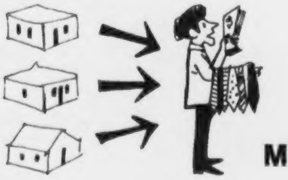
| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P | N | Q | M | A | N | U | F | A | C | T | U | R | I | N | G | G |
| J | N | O | N | S | I | K | K | U | Q | S | J | E | Z | W | Q | J |
| A | A | S | N | O | R | A | P | C | U | O | R | L | T | Y | A | B |
| S | T | C | S | D | D | I | A | B | B | A | R | T | E | R | E | D |
| S | U | I | I | E | U | U | N | I | F | O | R | E | M | A | N | Z |
| E | R | T | B | O | R | R | R | D | F | E | E | D | B | A | C | K |
| M | A | O | P | R | U | V | A | A | U | F | Q | K | V | A | B | F |
| B | L | B | R | E | Q | T | I | B | B | S | W | V | J | V | R | A |
| L | R | O | O | S | H | P | P | C | L | L | T | C | V | E | V | T |
| Y | E | R | D | O | A | R | I | U | E | E | E | R | B | I | H | Y |
| W | S | C | U | U | G | O | N | O | T | S | G | G | Y | U | Z | N |
| F | O | Y | C | R | Q | C | P | X | J | S | S | O | O | H | W | D |
| W | U | R | T | C | R | E | U | G | L | G | L | B | O | O | E | P |
| S | R | H | I | E | H | S | T | N | F | V | U | A | B | D | D | Z |
| Q | C | J | O | S | W | S | S | Y | O | U | B | N | B | T | S | S |
| N | E | W | N | G | L | E | C | A | D | V | G | U | P | O | F | R |
| U | F | H | A | D | T | S | V | Y | T | I | Z | S | Y | M | R | L |

# Historical Perspective of Manufacturing

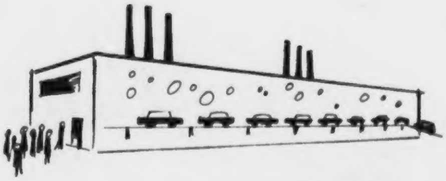
## (Major Milestones)


1200
HOME HANDICRAFT SYSTEM — Goods Made at Home; Excess Sold
1300
1400
1500
MERCANTILE SYSTEM — Goods Made at Home for Merchant
1600
1700
— Machines (the "Spinning Jenny," Water Frame, etc.)
Industrial Revolution
1800
— Mass Production
FACTORY SYSTEM — Goods Made at Factory
1900
— Assembly Line
— Computers and Automation
2000

**Family**



**Merchant**



**Factory**

# Manufacturing Divisions

Production

Industrial Relations

Marketing

Financial Affairs

Research and Development

# INTRODUCTION TO MANUFACTURING
## UNIT D-1

## INFORMATION SHEET

I. **Terms and definitions**

A. Assembly — The fitting together of parts to produce manufactured goods

B. Durable goods — Products that usually last at least three years

Examples: Furniture, refrigerators, automobiles, bicycles

C. Industry — Organization that utilizes resources to produce goods and services to meet the wants and needs of individuals

Examples: Agriculture, forestry, mining, construction, manufacturing, wholesale and retail trade, finance, insurance, real estate, transportation, communication, public utilities, entertainment, government

D. Labor — Human activity or services performed by workers

E. Manufacturing — Changing materials into usable products in a workshop or factory

F. Natural resource — A source of wealth or revenue supplied by nature and used by humans

G. Nondurable goods — Products that usually last fewer than three years

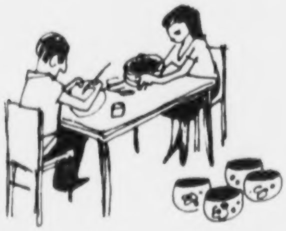
Examples: Clothing, food, toothpaste

H. Resources — Any items needed to manufacture a product

Examples: Materials, tools, people, capital, etc.

II. **Historical perspective of manufacturing**

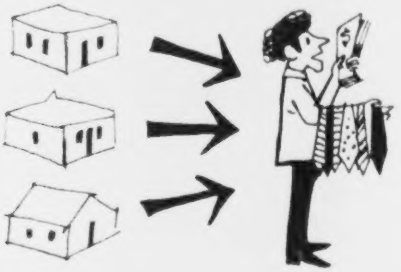
A. In the past most items were produced in the home for use in the home by family members. Any excesses were sold or traded (bartered). This is referred to as the **home handicraft system**



**Home Handicraft System**

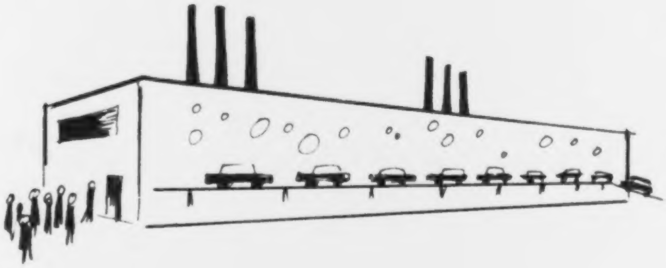
## INFORMATION SHEET

B. Later some people began to specialize in a craft and produced items in quantity at home that were sold to a merchant. The merchant then sold the items, along with items from other producers. This is referred to as the **mercantile system**.



**Mercantile System**

C. The Industrial Revolution is the time (1750-1850) when **machines** were used to make products instead of only hand tools, and when products were made in **factories** instead of homes.



**Factory System**

### III. Advantages and disadvantages of manufacturing

A. Advantages

1. Provides a large number of jobs
2. Makes products faster
3. Makes products cheaper
4. Provides easier repairs because of standardized parts

## INFORMATION SHEET

B. Disadvantages

1. Waste products from manufacturing processes can damage the environment.

   Examples: Air pollution from industry smokestacks, water pollution from toxic waste residue

2. New technologies used in manufacturing that increase production can also eliminate jobs.

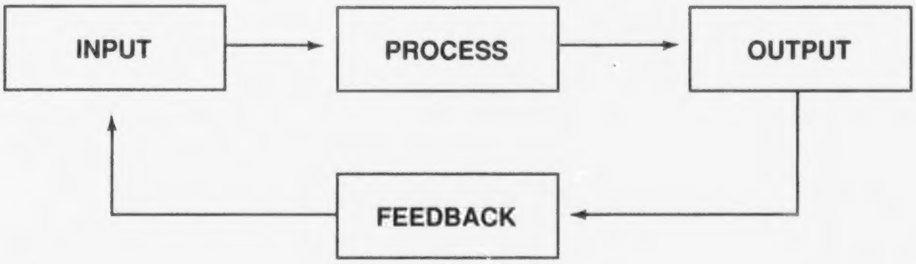
## IV. Interrelationship between manufacturing and the other technologies

A. **Energy, power, and transportation** — Manufacturing machines need energy sources and power systems to operate. Manufacturing also needs transportation to move raw materials and finished products and employees to work site. In return, manufacturing produces the parts needed by energy and power companies and all transportation vehicles.

B. **Communication** — Manufacturing companies need to communicate with their employees and the public about their products and services and use many communication devices and techniques. In return, manufacturing produces these communication devices in quantity.

C. **Construction** — Manufacturing needs structures for their factories, warehouses, and sales outlets as well as highways and bridges to get their products to the customers. In return, manufacturing makes many of the materials and tools used in construction.

## V. Parts of a manufacturing system model



A. Inputs — Natural resources, finance, capital, energy, human resources, and knowledge

B. Processes — Management practices, production processes, and personnel practices

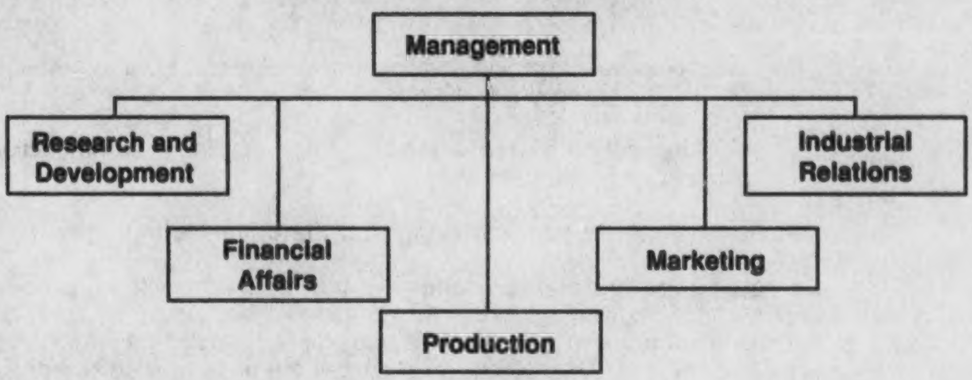
C. Outputs — Durable goods and nondurable goods

D. Feedback — Customer response, profit and loss, and quality control

## INFORMATION SHEET

VI. Divisions of a manufacturing organization and their functions

**Manufacturing Organization**


Management
Research and Development
Financial Affairs
Production
Marketing
Industrial Relations

A. Research and development — Identifying new products, processes, and services that can benefit the company

Examples: Drawing new products, testing new processes, building prototypes

**Research and Development**

## INFORMATION SHEET

B. Financial affairs — Managing the company's money

Examples: Purchasing new equipment, preparing payroll checks, paying bills

**Financial Affairs**

C. Production — Making the company's products

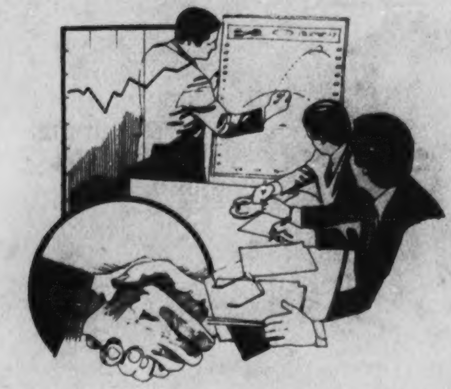
Examples: Tooling, assembling, finishing, packaging, quality control

**Production**

## INFORMATION SHEET

D. Marketing — Selling the company's products or services

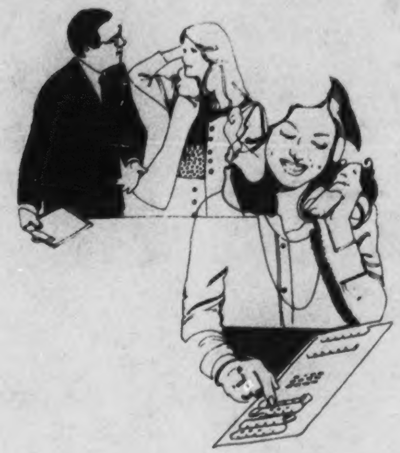
Examples: Surveying consumer preferences, creating advertisements



**Marketing**

E. Industrial relations — Ensuring positive relationships between company management, employees, and general public

Examples: Recruiting, hiring, and training employees, negotiating salaries and contracts, public relations



**Industrial Relations**

## INFORMATION SHEET

### VII. Job titles and tasks in manufacturing divisions

(NOTE: The number of people in each division will vary.)

| DIVISION | JOB TITLE | TASK |
|---|---|---|
| Production | • Supervisor | Oversees a major manufacturing operation. |
| | • Foreman | Oversees a particular group of tasks within a larger operation.<br>Example: Finishing room foreman |
| | • Worker | Controls and/or performs tasks necessary to produce the product.<br>Examples: Machinist, welder, painter, assembly worker |
| | • Quality control engineer | Oversees the inspection of completed products. |
| Research & Development | • Design engineer | Responsible for designing new products. |
| | • Laboratory technician | Responsible for fabricating and testing designs. |
| Industrial Relations | • Public relations director | Manages contacts with the environment outside the organization. |
| | • Personnel director | Enforces hiring, firing, and promotion policies and maintains employee records. |
| | • Training director | Meets the needs for training programs by establishing and evaluating instruction efforts. |

## INFORMATION SHEET

| DIVISION | JOB TITLE | TASK |
|---|---|---|
| Marketing | • Advertising manager | Coordinates the advertising of products and services. |
| | • Graphic designer | Designs and prepares advertisements. |
| | • Sales manager | Directs the efforts to sell company products and services. |
| | • Salesperson | Contacts potential consumers. |
| Financial Affairs | • Comptroller | Determines procedures and makes decisions regarding financial matters pertaining to the company. |
| | • Accountant | Maintains records of the organization's financial performance. |

(NOTE: There are many other jobs in addition to these.)

## INTRODUCTION TO MANUFACTURING
## UNIT D-1

## ASSIGNMENT SHEET #1—RESEARCH AND WRITE ABOUT AN INVENTOR OR INVENTION THAT CONTRIBUTED TO THE INDUSTRIAL REVOLUTION

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Points are well covered | ______ |
| Assignment is neat and completed on time | ______ |

Directions: Select one of the following inventors or inventions or one provided by your instructor, and write a brief summary below. Be prepared to read your summary aloud in front of the class.

A. Inventors/inventions

- Spinning jenny
- James Watt
- Samuel Slater
- Charles Hall
- Simeon North
- Henry Ford
- Labor unions
- Lillian and Frank Gilbreth
- Thomas Edison

B. Points to cover

1. Who was the inventor?
2. What was the invention?
3. How was it an advantage over the old method?
4. Is the invention still in use?

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

# INTRODUCTION TO MANUFACTURING
## UNIT D-1

## ASSIGNMENT SHEET #2—DESCRIBE SOCIETAL NEEDS THAT THE MANUFACTURING INDUSTRY HAS ADDRESSED DURING THE LAST TWO CENTURIES

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Answers are appropriate | ______ |
| Assignment is neat and completed on time | ______ |

Since the Industrial Revolution has virtually eliminated the independent farm family that raised its own food and made its own clothes, how has manufacturing served the needs of the dependent family units in our society?

Directions: Complete the following chart. Needs are listed on the left and the response by the manufacturing industry should be listed on the right.

| NEED | RESPONSE BY INDUSTRY |
|---|---|
| Example: Bread (food) | Sliced bread, cooked rolls, frozen bread dough, etc. |
| 1. Entertainment | |
| 2. Travel | |
| 3. Education | |
| 4. Housing | |
| 5. Food preparation | |
| 6. Health care | |
| 7. Textiles (clothing) | |
| 8. Furniture | |

## INTRODUCTION TO MANUFACTURING
## UNIT D-1

## ASSIGNMENT SHEET #3—RESEARCH A MANUFACTURING TECHNOLOGY CAREER

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Research is thorough | ______ |
| Report is complete | ______ |
| Assignment is neat and completed on time | ______ |

Directions: Examples of careers in the manufacturing field were discussed in Information Sheet. You may be able to name other careers also. Select a career you think you would be good in. Research for more details.

Examples:
1. What is the exact training needed?
2. Where can you get that training?
3. What are the working conditions for that job?
4. What are the future possibilities of employment?
5. Why would you be good at that job?

Compile the results of your research and present it either in written or oral form as requested by your instructor.

# INTRODUCTION TO MANUFACTURING
## UNIT D-1

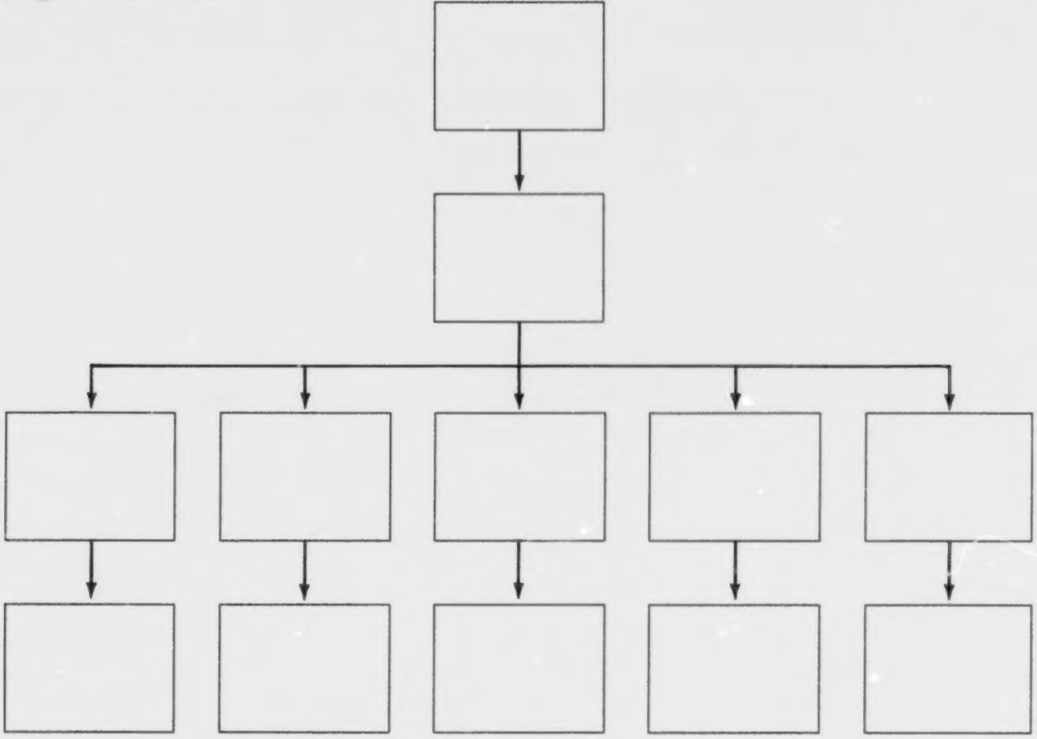
## ASSIGNMENT SHEET #4—ORGANIZE A CLASSROOM MANUFACTURING COMPANY

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Chart includes all divisions | ______ |
| Job titles are correctly categorized | ______ |
| Assignment is neat and completed on time | ______ |

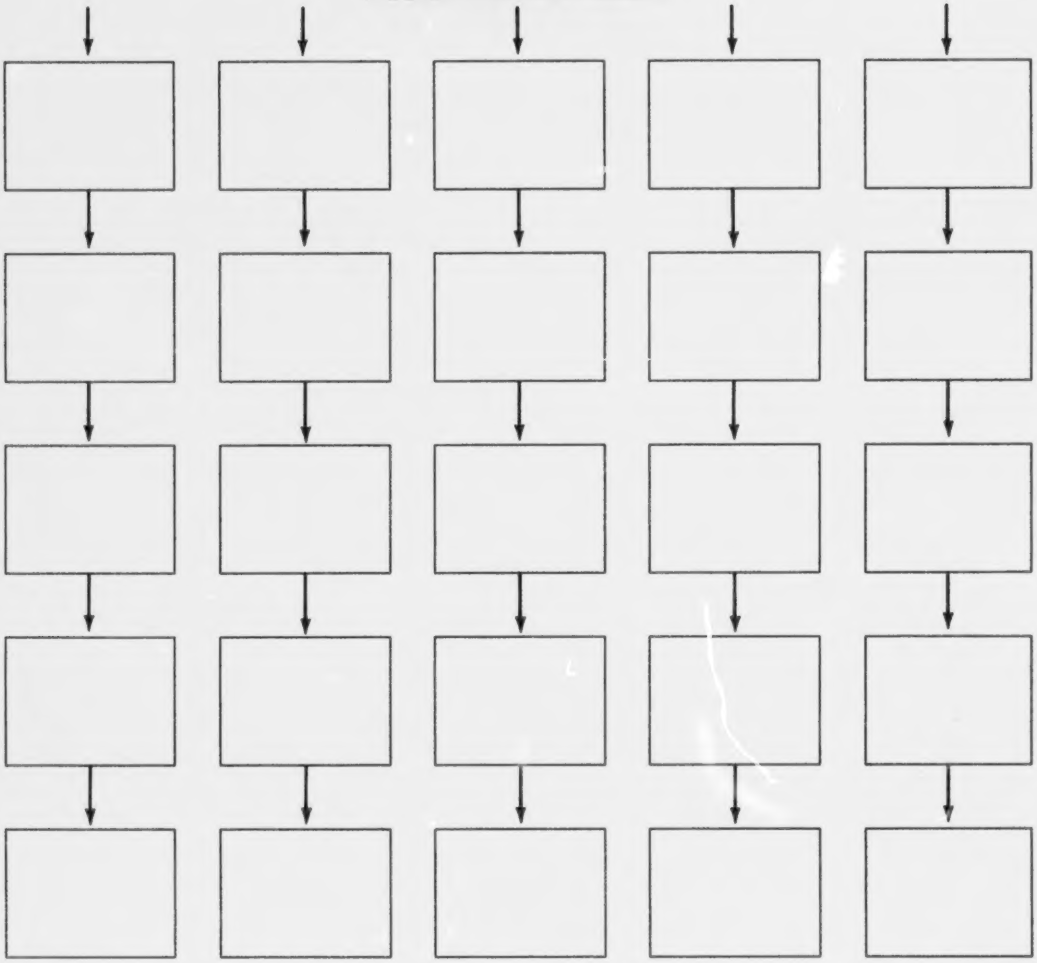
Directions: Prepare a classroom manufacturing organization chart that indicates all company divisions and job titles using the chart below. Place job titles in the appropriate boxes according to responsibility. If a box will not be used, place an "X" in it. Include the six divisions of manufacturing including management.

**Organization Chart**



Continue chart on next page.

## ASSIGNMENT SHEET #4



# INTRODUCTION TO MANUFACTURING
## UNIT D-1

## LAB ACTIVITY SHEET #1—PARTICIPATE IN AN ASSEMBLY-LINE ACTIVITY

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Assigned duties are followed | _____ |
| Procedure is accomplished | _____ |
| Cooperation and respect is shown | _____ |

A. This activity will present you with simulated manufacturing experience. The activity will last approximately 4-5 days. Each student will be assigned certain duties in the manufacturing enterprise. These job titles and duties may be rotated. After the job titles and duties are assigned by your instructor, management will organize the other students in class into a manufacturing organization.

B. Equipment and supplies:

Materials that need to be packaged (rocket kits, dragster kits, worksheets, booklets, etc.), styrofoam trays, plastic wrap, ID badge for each title, tests and worksheets to be stapled together, evaluation sheets, and computer system (including printer and word processing software).

C. Rules and regulations:

1. All students are to participate in activity.
2. When each student is assigned a job title, they will be evaluated by the supervising teacher. These students are to wear an identification badge.
3. Students will receive points from the manager that will be translated into check amounts.
4. All checks must be turned in at the end of the activity to receive the points acquired.
5. Each student may receive a maximum of 10 points per day.
6. Each student assigned a title may receive a maximum of 10 points per day by the supervising teacher.

## LAB ACTIVITY SHEET #1

D. Duties of management:

1. Manager's Duties — The manager is to evaluate each student's activities during the class hour. It is his/her responsibility to make sure everyone has something to do and that they do their duties correctly. The manager assigns jobs (given by supervising teacher) to students. All problems should be reported to the manager and if necessary the manager will report the problem to the teacher.

2. Assistant manager's duties — The assistant manager's duties consist of assisting the manager and checking the production items and ensuring quality. The assistant manager is to assist students with duties to ensure the duties are done properly. The assistant manager will communicate worker performance to the manager and assist in point assignment. If the manager is absent, the assistant manager performs the manager's duties.

3. Accountant's duties — The accountant's duties consist of keeping records on the computer and preparing reports for the manager. The accountant prepares checks for each student. These checks are to be signed by both the manager and the accountant. Each check and deposits are to be recorded on a computerized spreadsheet.

4. Foreman's duties — The foreman's responsibilities include announcing and supervising clean-up time. Supervising clean-up includes assigning clean-up jobs, equipment pick-up, and proper goggle storage. The foreman is evaluated by the quality of clean-up. The foreman represents the students in any problems. The foreman assists the accountant, quality control engineer, assistant manager, and manager as necessary.

5. Quality control engineer's duties — The quality control engineer's duties include inspection of employee performance, product quality, etc. It is his/her responsibility to make sure that the manufactured products meet the specifications. If the products are not meeting specifications, the quality control engineer reports the results to the company executives. If necessary, the quality control engineer can be assisted by the assistant manager.

E. Procedure:

1. Students are assigned certain duties in the packaging line on the conveyor table.

2. The management oversees all packaging activities.

F. Helpful tips and suggestions:

1. Cooperation is a necessity.

2. Respect all job titles and your co-workers.

## INTRODUCTION TO MANUFACTURING
## UNIT D-1

## TEST

Name ______________________________ Score ____________________

1. Match the terms on the right with the correct definitions.

______a. Organization that utilizes resources to produce goods and services to meet the wants and needs of individuals

______b. Human activity or services performed by workers

______c. Products that usually last fewer than three years

______d. Work performed to improve material goods or to benefit people

______e. A source of wealth or revenue supplied by nature and used by humans

______f. The fitting together of parts to produce manufactured goods

______g. Changing materials into usable products in a workshop or factory

______h. Automated machines used in the manufacture of products

1. Assembly
2. Durable goods
3. Industry
4. Labor
5. Manufacturing
6. Natural resource
7. Nondurable goods
8. Resources
9. Robotics
10. Services

2. Complete the following statements concerning a historical perspective of manufacturing by placing the best answer in the appropriate blank.

______a. The home handicraft system involved the production of most items

1) In the home, for use outside the home.
2) In the home, for use in the home.
3) Outside the home, for use in the home.

______b. When items are produced in quantity at home to be sold by a merchant, this is called the ______ system.

1) Assembly-line
2) Factory
3) Mercantile

## TEST

______c. The Industrial Revolution can be identified by which of the following key words?

1) Machines, homes
2) Machines, factories
3) Hand tools, homes
4) Hand tools, factories

3. Distinguish between the advantages and disadvantages of manufacturing by placing an "A" or "D" in the appropriate blanks.

______a. Waste products can damage the environment.

______b. Makes products faster

______c. Provides easier repairs because of standardized parts

______d. New technologies can eliminate jobs.

______e. Makes products cheaper

4. Discuss the interrelationship between manufacturing and other technologies by answering the following questions.

a. How does manufacturing need energy, power, and transportation? ________

______________________________________________

b. How does energy, power, and transportation need manufacturing? ________

______________________________________________

c. How does manufacturing need communication? ____________________

______________________________________________

d. How does communication need manufacturing? ____________________

______________________________________________

5. Categorize the following parts of a manufacturing system model. Label each of the following as either inputs (I), processes (P), outputs (O), or feedback (F).

______a. Management practices

______b. Capital

______c. Nondurable goods

______d. Customer response

______e. Finance

______ f. Human resources

______ g. Durable goods

______ h. Production practices

______ i. Natural resources

______ j. Personnel practices

## TEST

6. Match the divisions of a manufacturing organization on the right with the correct functions.

    ______a. Identifying new products, processes, and services that can benefit the company
    ______b. Making the company's products
    ______c. Managing the company's money
    ______d. Selling the company's products or services

    1. Financial affairs
    2. Industrial relations
    3. Marketing
    4. Production
    5. Research and development

7. Match the manufacturing divisions on the right with the correct job titles.

    ______a. Training director
    ______b. Design engineer
    ______c. Public relations director
    ______d. Salesperson
    ______e. Graphic designer
    ______f. Accountant
    ______g. Foreman

    1. Financial affairs
    2. Industrial relations
    3. Marketing
    4. Production
    5. Research and development

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

8. Research and write about an inventor or invention that contributed to the Industrial Revolution. (Assignment Sheet #1)

9. Describe societal needs that the manufacturing industry has addressed during the last two centuries. (Assignment Sheet #2)

10. Research a manufacturing technology career. (Assignment Sheet #3)

11. Organize a classroom manufacturing company. (Assignment Sheet #4)

12. Participate in an assembly-line activity. (Lab Activity Sheet #1)

## INTRODUCTION TO MANUFACTURING
## UNIT D-1

### ANSWERS TO TEST

1.

| | | | |
|---|---|---|---|
| a. | 3 | e. | 6 |
| b. | 4 | f. | 1 |
| c. | 7 | g. | 5 |
| d. | 10 | h. | 9 |

2.

| | |
|---|---|
| a. | 2 |
| b. | 3 |
| c. | 2 |

3.

| | |
|---|---|
| a. | D |
| b. | A |
| c. | A |
| d. | D |
| e. | A |

4. Discussions will vary. Answers may include:

   a. Need energy and power to operate machines and need transportation to move raw materials and finished products and employees to work site.
   b. Need manufacturing for parts and vehicles.
   c. Need communication for talking to their employees and the public about their products and services. Use many communication devices.
   d. Need manufacturing to produce communication devices.

5.

| | | | |
|---|---|---|---|
| a. | P | f. | I |
| b. | I | g. | O |
| c. | O | h. | P |
| d. | F | i. | I |
| e. | I | j. | P |

6.

| | |
|---|---|
| a. | 5 |
| b. | 4 |
| c. | 1 |
| d. | 3 |

7.

| | | | |
|---|---|---|---|
| a. | 2 | e. | 3 |
| b. | 5 | f. | 1 |
| c. | 2 | g. | 4 |
| d. | 3 | | |

8.-12. Evaluated to the satisfaction of the instructor.

# MANUFACTURING SYSTEMS
# UNIT D-2

## UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss the major manufacturing systems that are employed by industry. Competencies will be demonstrated by completing the assignment sheets and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to manufacturing systems with the correct definitions.
2. Distinguish among the types of manufacturing systems.
3. Match the types of automated manufacturing with the correct descriptions.
4. State criteria used in choosing an appropriate type of manufacturing system.
5. Match the items needed by a manufacturing enterprise with the correct descriptions.
6. State functions of management.
7. Select from a list the responsibilities of management.
8. Identify the forms of ownership of manufacturing enterprises.
9. Complete statements concerning the importance of different forms of ownership in the U.S.
10. List methods of obtaining capital resources.
11. State attributes that an employer looks for in an employee.
12. Identify and gather information about two businesses in your community. (Assignment Sheet #1)
13. Determine ways to obtain capital resources for a class manufacturing company. (Assignment Sheet #2)
14. Write a resume. (Assignment Sheet #3)
15. Complete a job application for the class manufacturing company. (Assignment Sheet #4)
16. Interview for a job in the class manufacturing company. (Assignment Sheet #5)

## MANUFACTURING SYSTEMS
## UNIT D-2

### SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher edition only and are designed to be used with the following objectives:

TM 1 — Types of Manufacturing Systems — Objective 2
TM 2 — Items Needed by a Manufacturing Enterprise — Objective 5
TM 3 — Functions of Management — Objective 6
TM 4 — Forms of Ownership — Objective 8

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. Use Teacher Supplement #1 to present AIT video D-2. This video was developed by the Agency for Instructional Technology (AIT) and a consortium of states to accompany this publication. Contact your state supervisor of technology education for copies, or contact AIT directly for more information:

   Agency for Instructional Technology (AIT)
   Box A, Bloomington, IN 47402
   800-457-4509 or 812-339-2203

2. Use Teacher Supplements #2 and #3 to help students understand this unit's terminology. Make copies (fronts only) for your students. The answers are on the backs of the supplements.

3. Discuss and provide examples of how management orchestrates the resources needed in a manufacturing organization.

4. Utilize the universal system model whenever a system or sub-system is discussed.

5. Inform your students that they will be participating in a simulated mass production activity.

## SUGGESTED ACTIVITIES

6. Use your available references to expand your presentation on writing resumes and applying for jobs.

7. Finalize the organizational structure (started in Assignment Sheet 4, Unit D-1) that will be used by the class to produce the product.

8. Have each student identify a company listed on the New York Stock Exchange and follow it for 2 weeks. Students can then provide a report of "their" company.

9. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Give test.

I. Evaluate test.

J. Reteach if necessary.

## ALTERNATE ACTIVITIES

A. Computerized simulation of CIM system.

B. Develop a model manufacturing system. The model should include a conveyor belt, robotic arms, lift systems, etc.

C. Utilize the manufacturing model components created by Fischertechnik. Available from:

Transtech Systems
Creative Learning Systems, Inc.
9889 Hibert St., Suite E
San Diego, CA 92131
619-566-2880

## RESOURCES USED IN DEVELOPING THIS UNIT

A. Bame, E. A. and Paul Cummings. *Exploring Technology.* Worcester, MA.: Davis Publications, Inc., 1980.

B. Heiner, Carl W. and Wayne R. Hendrix. *People Create Technology.* Worcester, MA: Davis Publications, Inc., 1980.

C. Lux, Donald and Willis Ray. *The World of Manufacturing.* Bloomington, IL: McKnight & McKnight.

D. Wright, R. Thomas and Richard M. Henak. *Exploring Production.* South Holland, IL: Goodheart-Willcox Co., Inc., 1985.

## RESOURCES USED IN DEVELOPING THIS UNIT

E. Komacek, Stanley, Ann E. Lawson, and Andrew C. Horton. *Manufacturing Technology*. Albany, NY: Delmar Publishers, Inc., 1990.

F. Fales, James F., et. al. *Manufacturing: A Basic Text*. Mission Hills, CA: Glencoe/McGraw-Hill, 1986.

G. Wright, R. Thomas. *Manufacturing: Material Processing, Management, Careers*. South Holland, IL: The Goodheart-Willcox Company, Inc., 1984.

H. Jambro, Donald J. *Introduction to Manufacturing*. Albany, NY: Delmar Publishers, Inc., 1982.

I. Hacker, Michael and Robert Barden. *Living with Technology*. Albany, NY: Delmar Publishers Inc., 1988.

J. *Missouri Introduction to Materials and Processing Technology Guide*. Columbia, MO: IML (Instructional Materials Laboratory), University of MO — Columbia 65202, 1989.

## SUGGESTED SUPPLEMENTAL RESOURCES

A. Videos

1. The following videotapes are available from:

   Bergwall Productions, Inc.
   P.O. Box 238
   Garden City, NY 11530-0238
   800-645-3565

   a. *Manufacturing Systems Explained:*

      1) *Inputs and Resources I*, 21:41 min.
      2) *Inputs and Resources II*, 14:09 min.

   b. *Factory of the Future*, 4 video series

2. *Modern Corporations*. 30 min. Available from:

   Sutherland Educational Films, Inc.
   201 North Occidental Boulevard
   Los Angeles, CA 90026

3. The following videos may be ordered from:

   Modern Talking Picture Service
   5000 Park Street North
   St. Petersburg, FL 33709-9989
   813-541-5763

## SUGGESTED ACTIVITIES

a. *American Enterprise*, series of five films, color - each film 30 min.
*Government, Innovation, Land, Organization, People*

b. *Commitment to the Future*, 29 min.

c. *New Engineers*, 27 min.

d. *The Company We Keep*, 25 min.

4. *Manufacturing Systems*. Color. 13 min. Available from:

Agency for Instructional Technology
Box A
Bloomington, IN 47402
800-457-4509

B. Periodicals

1. *Furniture Design and Manufacture*
Delta Communication, Inc.
400 N. Michigan Ave.
Chicago, IL 60611

2. *Mechanical Engineer*
American Society of Mechanical Engineering
345 E. 47th Street
New York, NY 10017
212-392-8876

# MANUFACTURING SYSTEMS
# UNIT D-2

## TEACHER SUPPLEMENT #1 — USING AIT VIDEO D-2

### Introduction and Program Summary (13:03)

This program introduces the three major types of manufacturing systems and the four essential resources necessary for a manufacturing system to succeed.

The program opens by introducing the three manufacturing systems: custom, intermittent, and continuous. A colonial craftsman making shoes and a modern violin-maker, who is profiled, are examples of custom manufacturing producing handmade products, one at a time. A modern printing plant printing to fill customer orders is an example of intermittent manufacturing in a job shop. The program then visits Intergraph Computers, a large plant where highly automated, assembly line production is used in a continuous manufacturing system to make CAD-CAM computer systems. Viewers see how all components—chips, memory boards, switches, wires, and monitors—are tested separately, then assembled and retested. Leroy Cole, director of manufacturing engineering, is profiled as he explains the exhaustive quality testing process.

The second part of the program introduces the four essential resources for manufacturing—finance, materials, people, and facilities—and tells the story of Steven Wozniak and Steven Jobs, founders of Apple Computer Company. They started with an idea and expertise, acquired materials, financing, and finally a large, modern facility. The story is analyzed in terms of the system model, in which the four resources provide the input, the manufacture of computers is the process, the finished computers are the output, and their success and sales constitute the feedback. In the future, talking computers may be common. Students are asked, "How will they change manufacturing?"

### Video Program Objectives

The video program will illustrate

- different types of manufacturing systems
- essential elements involved in a manufacturing enterprise

### Before the Program

1. Tell your students this lesson is about different types of manufacturing systems and their essential elements. Hold up a handmade item. Say that one type of manufacturing system was used to manufacture it. Say that another type of manufacturing system was used to produce the cars in the parking lot. Tell students this video program will explain three different types of manufacturing. You will expect them to explain the differences among these.

2. Ask students to tell you what things they believe are necessary to produce a product. List a few of these on the board as they are mentioned. Tell students to watch the video program carefully to see if any of these or any others are mentioned.

## TEACHER SUPPLEMENT #1

3. Tell students what they will be doing in the lab, and how the content of the video program will set the stage for the laboratory activity.

4. Tell students to note the following in the video program: the three different types of manufacturing systems; the essential resources involved in a manufacturing enterprise; examples of manufacturing systems.

5. Tell students to listen for the following terms. (You might write them on the chalkboard.)

system
handmade
CAD/CAM
finance
automation
enterprise
investors
job shop
facilities
materials
stock
machinery
intermittent manufacturing
continuous manufacturing
custom manufacturing

**After the Program: Questions for Discussion and Review**

1. What is a system? (*collection of several parts that work together for one purpose*)

2. What are the three types of manufacturing systems? Describe, giving the example from the video program: custom manufacturing (*producing items one at a time—violins*); intermittent manufacturing (*producing products in limited production runs to fill customer orders—greeting cards*); continuous manufacturing (*mass producing great numbers of a product in a continuous run—computers).*

3. What type of manufacturing system was used to manufacture the automobiles in the parking lot? The handmade item held up at the beginning of the class? *(**the automobile:** continuous manufacturing system; **the handmade item:** custom manufacturing process.)*

4. What are the essential elements necessary for manufacturing? Give an example of each. *(**finance**: money from investors, banks, and stock sales; **materials:** paper and ink for greeting cards; wood and varnish for violins; chips, wires, switches for computers; **people:** to design, manage, organize, and work in manufacturing; **facilities**: workshops and factories where products are produced.)*

5. What are other elements that might be considered in the manufacturing of products? *(Time, energy, knowledge, other—student input and discussion.)*

6. Describe the manufacturing system in terms of the systems model. *(**Inputs**: finance, materials, people and facilities; **processes:** the various manufacturing processes—casting and molding, assembling, etc; **outputs**: manufactured products—computers, jeans, candy bars, etc; **feedback:** the response of the public to the products and the product quality—sales.)*

## TEACHER SUPPLEMENT #1

7. Describe Apple computer in terms of changes in their manufacturing system and the essential elements in manufacturing, from the building of their initial computer to present day operations (*Originally the computers were hand-assembled, one at a time—the custom system. The company progressed until it was able to manufacture computers continuously. Financing of the operation began with personal investing, then bank loans, then possibly stock sales. Originally facilities consisted of a garage workshop, but are now a highly automated factory.)*

8. How will talking computers change manufacturing? How will manufacturing change in the future? *(student discussion)*

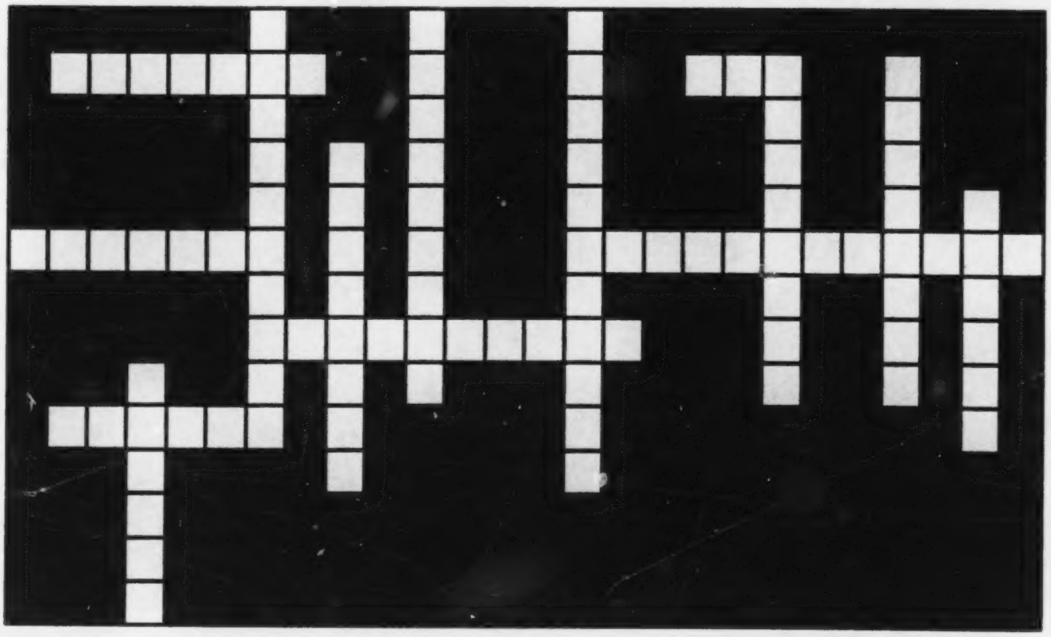
# MANUFACTURING SYSTEMS
# UNIT D-2

## TEACHER SUPPLEMENT #2—CRISS CROSS

Name ______________________________ Date ________________

Directions: Fit the words below into the criss cross pattern.

ENTREPRENEUR
CONSUMERS
CAPITAL
VOLUME
PARTNERSHIP
MONOPOLY
FINANCE
CIM
ENTERPRISE
ROBOTICS
PROFIT
MANAGEMENT
PLANNING
CUSTOM



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## TEACHER SUPPLEMENT #2

## CRISS CROSS ANSWER KEY

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | C | A | P | I | T | A | L | | | O | | | | A | | | C | I | M | | | P | | | |
| | | | | | | N | | | | N | | | | R | | | | | O | | | L | | | |
| | | | | | | A | | R | | S | | | | T | | | | | N | | | A | | | |
| | | | | | | G | | O | | U | | | | N | | | | | O | | | N | | C | |
| F | I | N | A | N | C | E | | B | | M | | | | E | N | T | R | E | P | R | E | N | E | U | R |
| | | | | | | M | | O | | E | | | | R | | | | | O | | | I | | S | |
| | | | | | | E | N | T | E | R | P | R | I | S | E | | | | L | | | N | | T | |
| | | | V | | | N | | I | | S | | | | H | | | | | Y | | | G | | O | |
| | P | R | O | F | I | T | | C | | | | | | I | | | | | | | | | | M | |
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# MANUFACTURING SYSTEMS
# UNIT D-2

## TEACHER SUPPLEMENT #3—SUPER WORD SEARCH

Name ______________________________ Date ____________________

Directions: Write the words that match the clues in the blank spaces. Then find and circle the words in the puzzle.

A business organization ____________________
Business which is the only producer for a product ____________________
Complete integration of computers and manufacturing ____________________
"Enterpriser" ____________________
Quantity to be produced ____________________
Economic reward for filling needs and wants ____________________
Deciding what to do and how to do it ____________________
Money needed to start an enterprise ____________________
Two or more owners ____________________
Oldest type of manufacturing ____________________
Plan, organize, control, and direct ____________________
The public or possible customers ____________________
"Intelligent" automated machines ____________________
Money, building, machinery, etc. ____________________
Shares of ownership of a corporation ____________________

| | | | | | | | | | | | | | | |
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| U | H | A | E | N | T | R | E | P | R | E | N | E | U | R |
| W | K | M | N | D | N | R | K | Q | A | C | L | V | R | I |
| F | E | R | O | A | C | C | C | Z | S | T | O | C | K | S |
| I | N | O | P | N | G | A | U | I | S | I | P | L | L | M |
| N | T | B | C | L | O | E | P | S | M | W | R | S | F | H |
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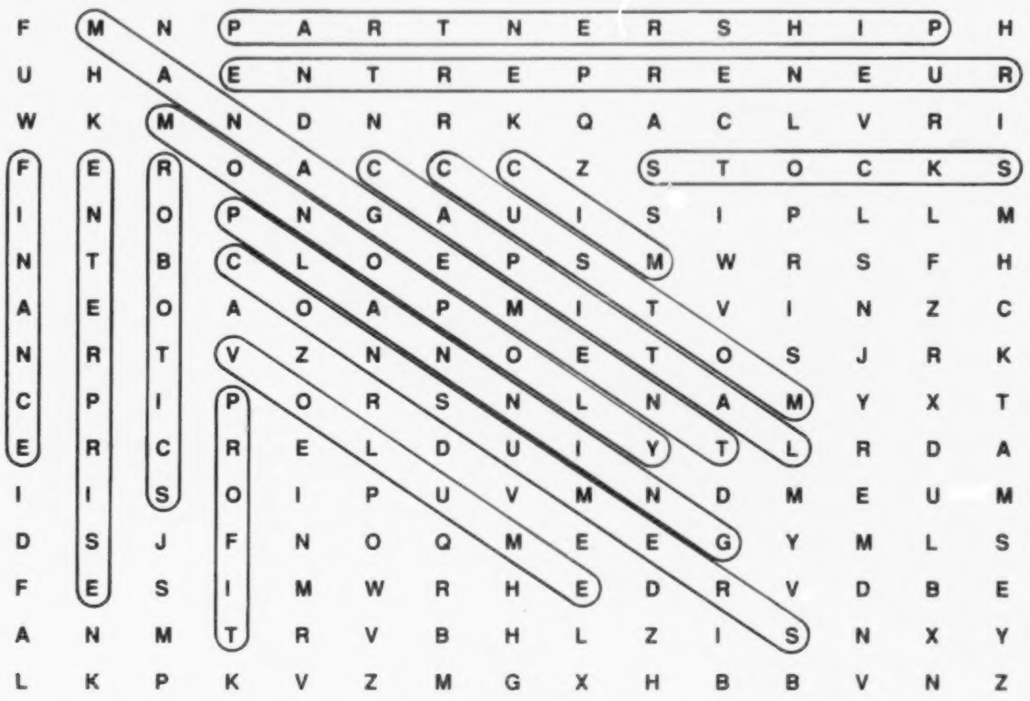
| N | R | T | V | Z | N | N | O | E | T | O | S | J | R | K |
| C | P | I | P | O | R | S | N | L | N | A | M | Y | X | T |
| E | R | C | R | E | L | D | U | I | Y | T | L | R | D | A |
| I | I | S | O | I | P | U | V | M | N | D | M | E | U | M |
| D | S | J | F | N | O | Q | M | E | E | G | Y | M | L | S |
| F | E | S | I | M | W | R | H | E | D | R | V | D | B | E |
| A | N | M | T | R | V | B | H | L | Z | I | S | N | X | Y |
| L | K | P | K | V | Z | M | G | X | H | B | B | V | N | Z |

*Duplication Permitted*

## TEACHER SUPPLEMENT #3

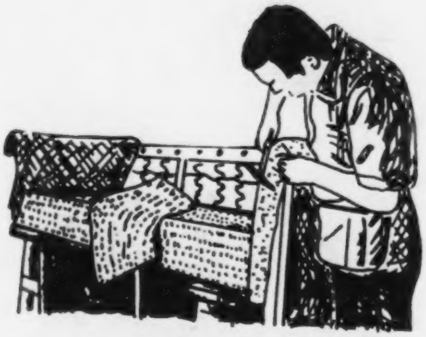
## SUPER WORD SEARCH ANSWER KEY

| | |
|---|---|
| A business organization | ENTERPRISE |
| Business which is the only producer for a product | MONOPOLY |
| Complete integration of computers and manufacturing | CIM |
| "Enterpriser" | ENTREPRENEUR |
| Quantity to be produced | VOLUME |
| Economic reward for filling needs and wants | PROFIT |
| Deciding what to do and how to do it | PLANNING |
| Money needed to start an enterprise | FINANCE |
| Two or more owners | PARTNERSHIP |
| Oldest type of manufacturing | CUSTOM |
| Plan, organize, control, and direct | MANAGEMENT |
| The public or possible customers | CONSUMERS |
| "Intelligent" automated machines | ROBOTICS |
| Money, building, machinery, etc. | CAPITAL |
| Shares of ownership of a corporation | STOCKS |

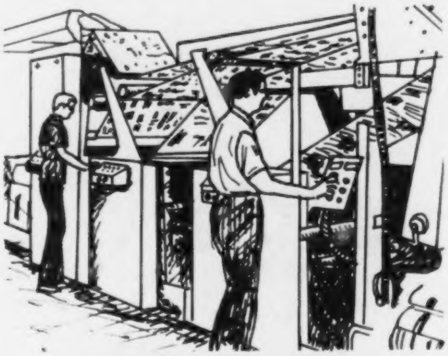


| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F | M | N | P | A | R | T | N | E | R | S | H | I | P | H |
| U | H | A | E | N | T | R | E | P | R | E | N | E | U | R |
| W | K | M | N | D | N | R | K | Q | A | C | L | V | R | I |
| F | E | R | O | A | C | C | C | Z | S | T | O | C | K | S |
| I | N | O | P | N | G | A | U | I | S | I | P | L | L | M |
| N | T | B | C | L | O | E | P | S | M | W | R | S | F | H |
| A | E | O | A | O | A | P | M | I | T | V | I | N | Z | C |
| N | R | T | V | Z | N | N | O | E | T | O | S | J | R | K |
| C | P | I | P | O | R | S | N | L | N | A | M | Y | X | T |
| E | R | C | R | E | L | D | U | I | Y | T | L | R | D | A |
| I | I | S | O | I | P | U | V | M | N | D | M | E | U | M |
| D | S | J | F | N | O | Q | M | E | E | G | Y | M | L | S |
| F | E | S | I | M | W | R | H | E | D | R | V | D | B | E |
| A | N | M | T | R | V | B | H | L | Z | I | S | N | X | Y |
| L | K | P | K | V | Z | M | G | X | H | B | B | V | N | Z |

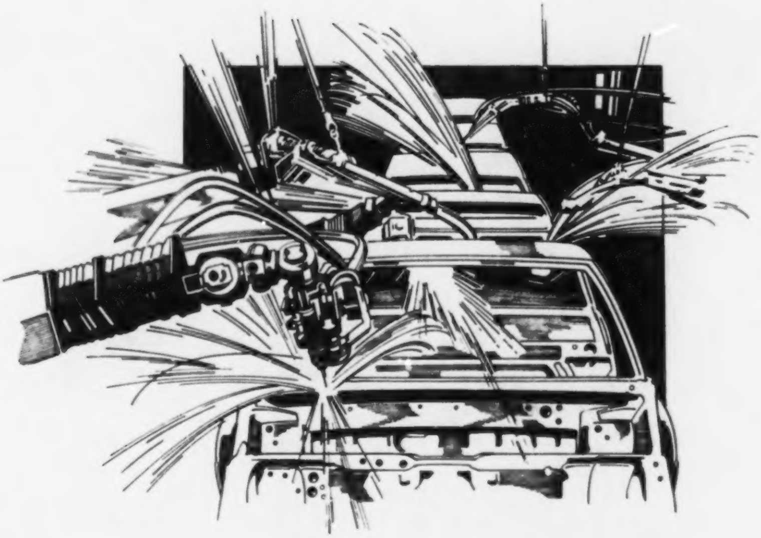
# Types of Manufacturing Systems



Custom Manufacturing

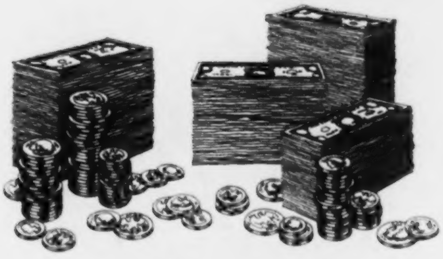


Intermittent Manufacturing

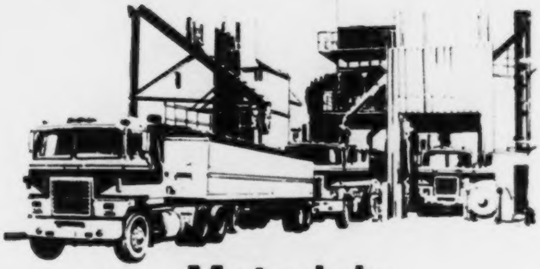


Continuous Manufacturing (Mass Production)

# Items Needed by a Manufacturing Enterprise



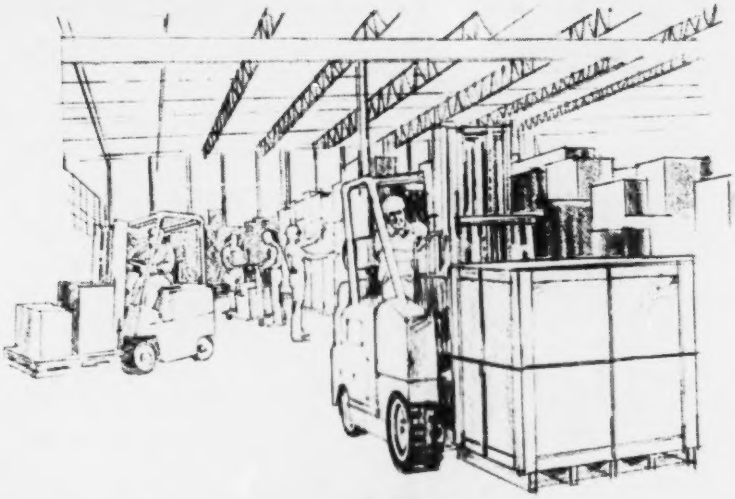
Finance



Materials

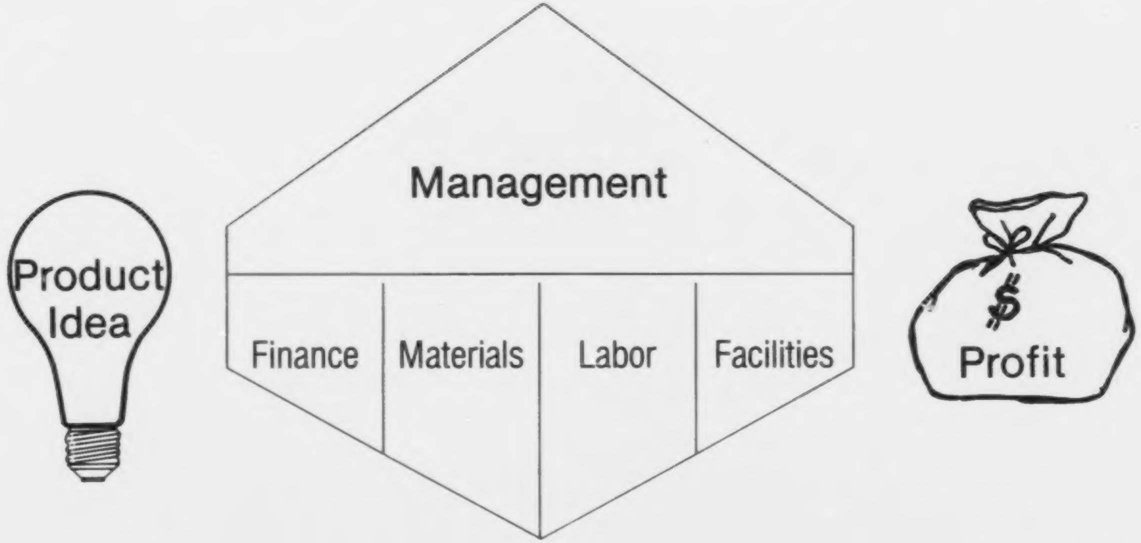
Management

Labor



Facilities

# Functions of Management



Product Idea

Management

Finance

Materials

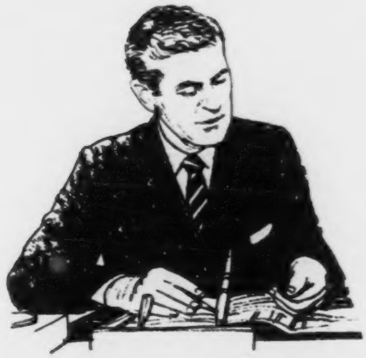
Labor

Facilities

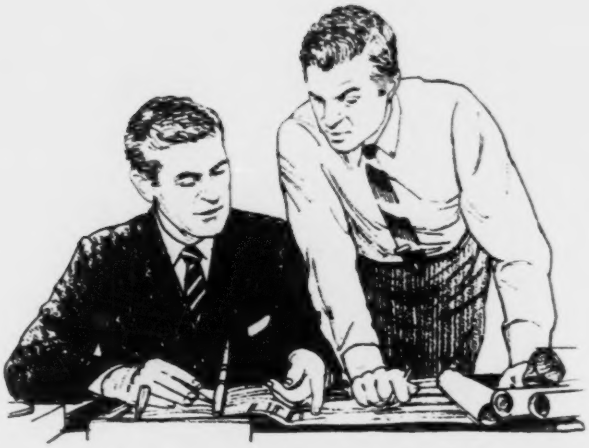
$ Profit

**Management** plans, organizes, directs, and controls the other four resources.

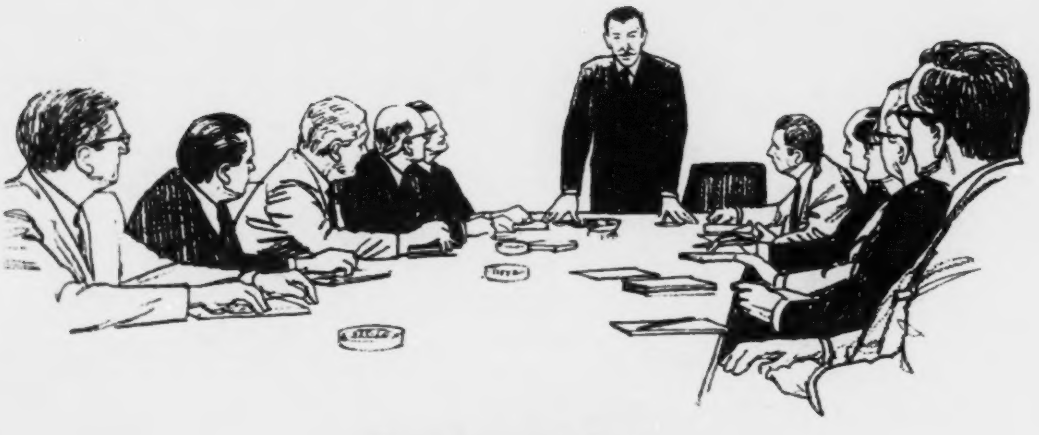
# Forms of Ownership



**Proprietorship**



**Partnership**



**Corporation**

# MANUFACTURING SYSTEMS
## UNIT D-2

## INFORMATION SHEET

I. **Terms and definitions**

A. Capital — Money, buildings, machinery, and investments that are used, or available, to make products or services

B. Consumers — The public or potential customers

C. Enterprise — A business organization

D. Entrepreneur — French word meaning "enterpriser"; a person who owns his or her own business

E. Free enterprise — Marketing-centered political/economic system which encourages as little government intervention and control as possible

F. Monopoly — Business which is the only producer of a good or service; one which has no competition

G. Profit — Economic reward for filling the needs and wants of consumers; return received by a business after all operating expenses have been paid

II. **Types of manufacturing systems**

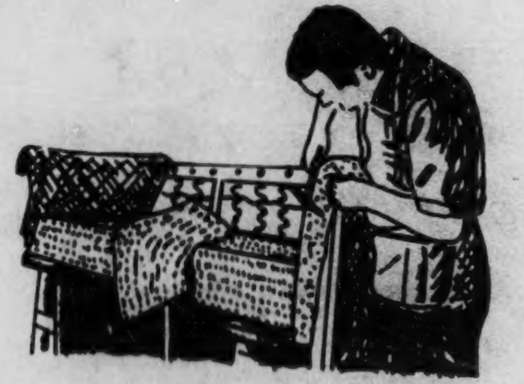
A. Custom manufacturing

1. Oldest type of manufacturing.

2. Characterized by skilled craftsmen producing individual or limited quantity items.

3. Mechanized and/or automated production techniques are not used and the cost is very high.

Example: Custom-made furniture



**Custom Manufacturing**

## INFORMATION SHEET

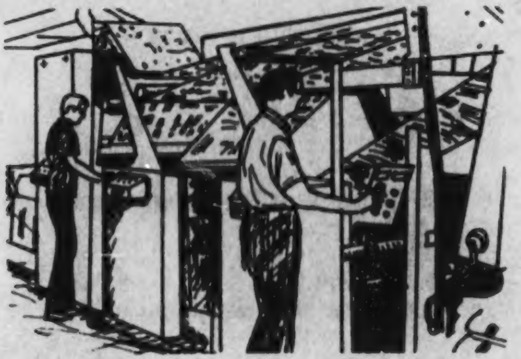
B. Intermittent manufacturing

1. Used when the volume of products needed is too low for continuous manufacturing.

2. Products are often produced in groups or lots.

3. Companies involved in this type of manufacturing are often called job shops since they contract or take orders for specific jobs or quantities.

   Examples: Book printers, welding shops, machine shops



**Intermittent Manufacturing**

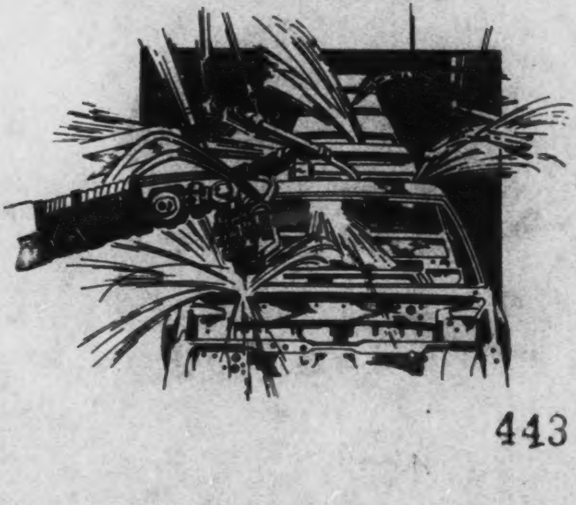
C. Continuous manufacturing

1. Used when large quantities of the product are needed.

2. Utilizes both automation and mechanization to reduce labor needs and hand operations.

3. Standardized parts and components must be on hand for continuous flow of the line.

   Example: Automobile factory

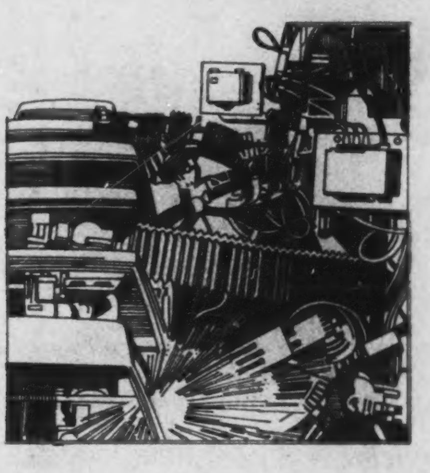


**Continuous Manufacturing (Mass Production)**

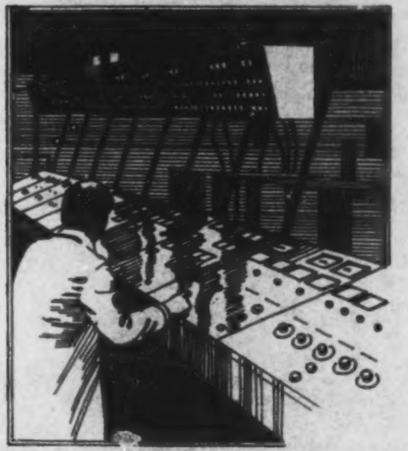
## INFORMATION SHEET

### III. Types of automated manufacturing

A. Robotics — "Intelligent" automated machines with sensors that are controlled by a computer; usually replace workers in dangerous, boring, heavy, or unpleasant jobs.



B. CAD/CAM (Computer-Aided Design/Computer-Aided Manufacturing) — The integration of computers with design and manufacturing. Allows one to design on the computer, translate the drawing into numerical data, and produce the product with a machine that is computer-controlled using the numerical data

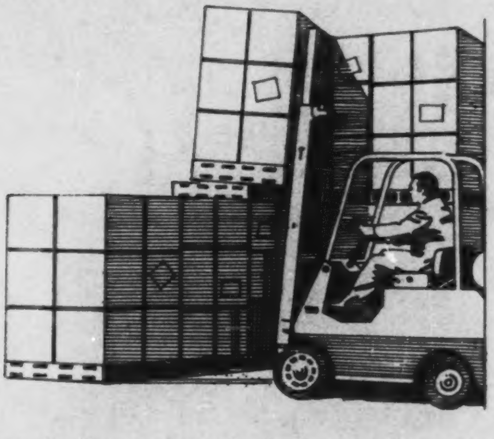


C. CIM (Computer-Integrated Manufacturing) — The complete integration of computers and manufacturing; computers are used throughout the manufacturing system

## INFORMATION SHEET

D. FMS (Flexible Manufacturing System) — A manufacturing system that can be adapted easily for producing different products

E. JIT (Just-In-Time Manufacturing) — The method of making sure that raw materials and purchased parts arrive at the factory just in time to be used on the production line



### IV. Criteria used in selecting a manufacturing system

A. Volume (the quantity to be produced)

B. Availability of necessary inputs (people, capital, materials, tools and machines)

C. Type(s) of products to be made

D. Life cycle or durability of a product

E. Production philosophy of the organization

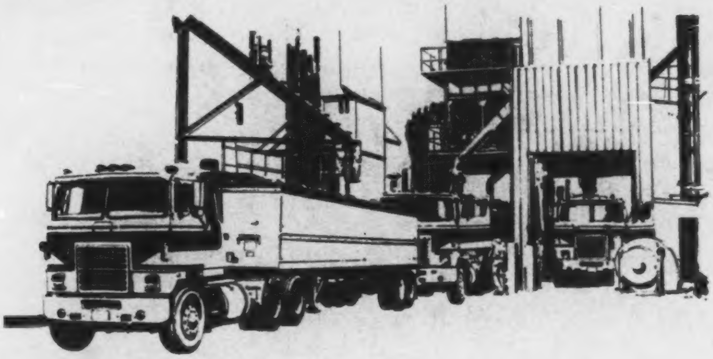
### V. Items needed by a manufacturing enterprise

(NOTE: Every manufacturing enterprise starts with an idea of a product which may be made for profit. The following five items are necessary to convert an idea into a profit-making organization.)

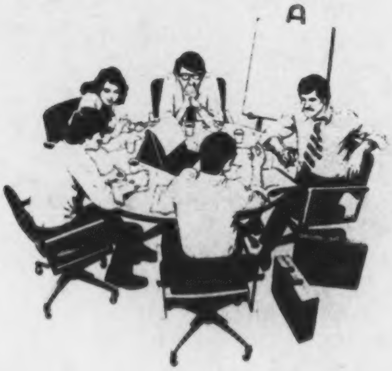
A. Finance — The money needed to start and maintain a manufacturing enterprise

## INFORMATION SHEET

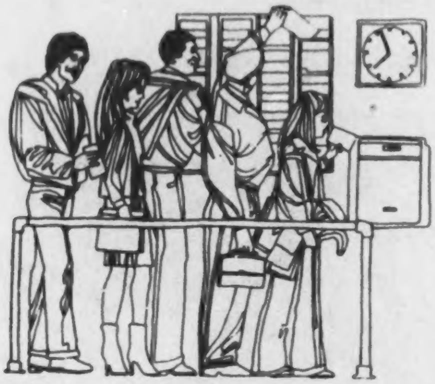
B. Materials — All items used to manufacture a product



C. Management — People who plan, organize, direct, and control the manufacturing enterprise

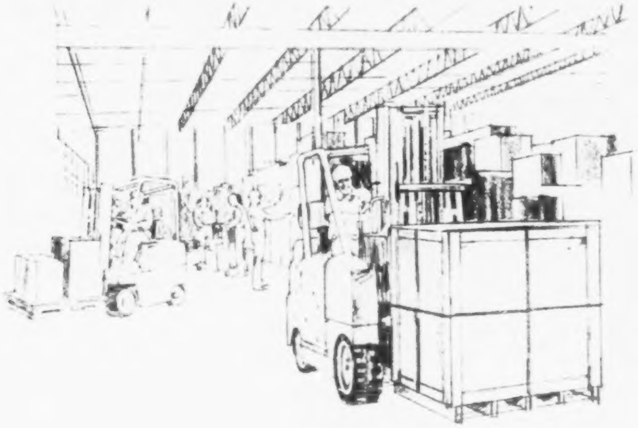


D. Labor — People who perform the manufacturing operations



## INFORMATION SHEET

E. Facilities — All the physical things needed to convert the materials to a product; includes all utilities, energy resources, buildings, and equipment



## VI. Functions of management

(NOTE: Management plans the form and structure of the enterprise and makes sure the other resources work together to produce a profit.)

A. Planning — Deciding what to do and how to do it

B. Organizing — Grouping individuals to work together to achieve goals of company

C. Directing — Guiding and motivating workers

D. Controlling — Governing people, materials, and other resources associated with the manufacturing system

## VII. Responsibilities of management

A. Make a profit for company owners

B. Protect company employees

C. Satisfy the needs and wants of the consumers

D. Create a positive effect on local communities

E. Develop an efficient organization

## INFORMATION SHEET

**VIII. Forms of ownership of manufacturing enterprises**

A. Individual proprietorship — Has one owner

B. Partnership — Has two or more owners

C. Corporation — Has many owners, sometimes thousands

Examples: American Telephone and Telegraph (AT&T), General Electric

**IX. Importance of different forms of ownership in the United States**

A. Corporations are by far the strongest force in our economy.

1. They account for over 75% of all products and services provided.
2. They employ over 80% of the work force.

## INFORMATION SHEET

B. However, most businesses are individual proprietorships.

1. They account for more than 75% of all industrial firms.

2. This means that 3 out of every 4 businesses are owned by individuals even though more than 75% of all goods and services are provided by corporations.

**X. Methods of obtaining capital resources**

A. Individual proprietorships and partnerships obtain capital resources from:

1. Private savings of the owners

2. Loans from banks, finance companies, or friends

3. A combination of savings and loans

B. A corporation obtains capital resources by selling securities — stocks or bonds.

1. Stocks — Are shares of ownership of a corporation. They earn money for the shareholder in the form of dividends (% of net profits).

2. Bonds — Are certificates of public or private indebtedness. (You loaned the company money and they promise to pay you back.) They earn money for the bond owner in the form of interest.

**XI. Attributes an employer looks for in an employee**

A. Enthusiasm and interest

(NOTE: This includes taking pride in your work.)

B. Dedication and dependability

(NOTE: This involves good work habits which include regular attendance and being on time.)

C. Alertness, quickness of mind (safety-minded)

D. Honesty and integrity

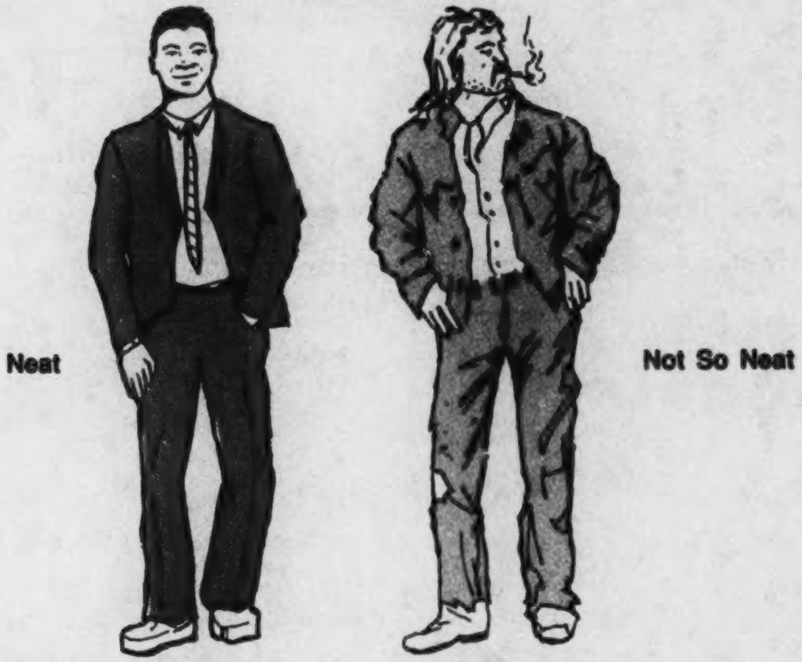
E. Desire to work

F. Ability to work with others and to follow orders

G. Desire to improve oneself

H. Neat, clean appearance

## INFORMATION SHEET



I. No evidence of drug or alcohol use affecting job performance

J. Decision-making ability

K. Problem-solving ability

L. Competency in necessary skills

## MANUFACTURING SYSTEMS
## UNIT D-2

### ASSIGNMENT SHEET #1 — IDENTIFY AND GATHER INFORMATION ABOUT TWO BUSINESSES IN YOUR COMMUNITY

Name ______________________ Overall Rating ________

| EVALUATION CRITERIA | RATING |
|---|---|
| Information is complete | ______ |
| Assignment is neat and completed on time | ______ |

Directions: Look around in your community and write down the names of two business firms that you know. Make sure at least one is a manufacturing firm. Write their names and other information on the following form:

BUSINESS NO. 1

Name of firm: ______________________

Function of this firm: ______________________

______________________

Name of owner: ______________________

Name of president of firm: ______________________

Number of employees: ______________________

Product handled: ______________________

Does this firm actually make the product it sells? ______________________

If no, then who does make it? ______________________

______________________

BUSINESS NO. 2

Name of firm: ______________________

Function of this firm: ______________________

______________________

Name of owner: ______________________

Name of president of firm: ______________________

## ASSIGNMENT SHEET #1

Number of employees: ______________________________

Product handled: ______________________________

Does this firm actually make the product it sells? ______________________________

If no, then who does make it? ______________________________

______________________________

## MANUFACTURING SYSTEMS
## UNIT D-2

## ASSIGNMENT SHEET #2—DETERMINE WAYS TO OBTAIN CAPITAL RESOURCES FOR A CLASS MANUFACTURING COMPANY

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Ways listed are possible | ______ |
| Assignment is neat and completed on time | ______ |

Directions: Companies have several different ways of obtaining capital resources for their company's operation. As a class manufacturing company, you will need to find capital resources to support your operations. The class is to be divided into groups of 4 or 5 students and each group is to conduct a "brainstorming" session over ways to obtain capital resources. List the ways your group thought of below.

1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

5. ______________________________

## MANUFACTURING SYSTEMS
## UNIT D-2

### ASSIGNMENT SHEET #3—WRITE A RESUME

Name ______________________________ Overall Rating __________

| EVALUATION CRITERIA | RATING |
|---|---|
| Resume is complete | _____ |
| Resume is positive | _____ |
| Assignment is neat and completed on time | _____ |

Directions: Write a resume using accurate facts about yourself. Use the information below as a guide. A good resume should immediately give prospective employers a brief summary of your accomplishments, educational background, work experience, skills, and job objective. It is not necessary to use the exact wording and outline form, but it is necessary that your resume be neat and balanced and contain all the information which might help you get a job.

Guidelines:

1. Use either a typewriter or a computer with a word processor.
2. Type RESUME at the top of the page, centered.
3. Start the resume with your name, address, and phone number.

   Example:

   John Doe

   ADDRESS: 785 Technology Drive
   YourTown, YourState Zipcode
   Phone Number

4. Next list personal data such as birthdate, health, and social security number.

   Example:

   PERSONAL DATA

   Birthdate: October 23, 1976

   Health: Excellent

   Social Security Number: 000-00-0000

## ASSIGNMENT SHEET #3

5. List the job(s) that you are applying for.

   Example:

   JOB OBJECTIVE: Class company accountant

6. List your educational background. Include school name, address, certificate/degree, grade average (GPA), etc.

   Example:

   EDUCATION: Roosevelt High School, diploma, 3.1 GPA

7. List any subjects that are directly related to the job you are applying for.

   Example:

   RELATED SUBJECTS STUDIED: Business math, accounting, typing

8. List any organizational activities that you have participated in.

   Example:

   ORGANIZATIONAL ACTIVITIES: Math club, key club

9. List all work experience including the business name and address, job title, dates employed, supervisor name, and duties. Start with the most recent.

   Example:

   WORK EXPERIENCE

   Name: MAVCC
   1564 Technology Ave.
   Your Town, Your State Zip Code
   Phone Number

   Job Title: Janitor

   Dates: April 1, 1988, to August 1, 1988

   Supervisor: Mr. Aaron Murray

   Duties: clean hallways, gather trash, trim shrubs

## ASSIGNMENT SHEET #3

10. List character references including name, address, and telephone number

(NOTE: Do not list references without their permission.)

Example:

REFERENCES (listed with permission)

Mary Smith
777 Main Street
Your Town, Your State Zip Code
Phone Number

James White, M.D.
Suite 122
1000 Industrial Park
Your Town, Your State Zip Code
Phone Number

## MANUFACTURING SYSTEMS
## UNIT D-2

### ASSIGNMENT SHEET #4—COMPLETE A JOB APPLICATION FOR THE CLASS MANUFACTURING COMPANY

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Job application is complete | _____ |
| Assignment is neat and completed on time | _____ |

Directions: Complete the following application form using the guidelines below.

(NOTE: Although each business uses its own form, general rules of preparation apply to any form.)

1. Be prepared.
   a. Take a good ink pen with you.
   b. Take copies of resume.
2. Look over entire form before starting to write; do not hurry.
3. Follow directions.
4. Write or print clearly, neatly, and legibly.
5. Answer briefly.
6. Be honest.
7. Answer all questions.

   (NOTE: If questions do not apply to you, write Not Applicable or NA in the space to show that you did not overlook the question.)
8. Include complete information; use resume.
9. Recheck application when finished.
10. Avoid cross-outs and obvious erasure marks.

## ASSIGNMENT SHEET #4

______________
(Date)

## APPLICATION FOR EMPLOYMENT

**PRINT IN INK OR TYPE**

**Personal Data:**

Last Name ______________ First ______________ Middle ______________

Address ______________________________________________

City, State, Zip ______________________________________________

Home Phone (____) ______ - ______ Work Phone (____) ______ - ______

If you have no phone, name of person and phone number where we may leave a message for you ______________

______________________________________________

Social Security Number ______ - ______ - ______

**Education Data:**

| SCHOOL | NAME & LOCATION OF SCHOOL | COURSE OF STUDY OR MAJOR/MINOR | NO. OF YEARS OR HOURS COMPLETED | DIPLOMA OR CERTIFICATE RECEIVED |
|---|---|---|---|---|
| Junior High | | | | |
| High School | | | | |
| Vocational-Technical School | | | | |
| College/University | | | | |
| Other | | | | |

**Employment Data:** (Start with present or most recent employment)

1. Company ______________ Telephone (____) ______ - ______
Address ______________ Employed from ________ to ________
Name of Supervisor ______________ Part-time ☐ Full-time ☐
Job Title and Type of Duties Performed ______________ Reason for Leaving ______________

86-D

# ASSIGNMENT SHEET #4

2. Company
Address
Name of Supervisor
Job Title and Type of Duties Performed

Telephone ( ) -
Employed from to
Part-time ☐ Full-time ☐
Reason for Leaving

3. Company
Address
Name of Supervisor
Job Title and Type of Duties Performed

Telephone ( ) -
Employed from to
Part-time ☐ Full-time ☐
Reason for Leaving

May we contact the employers listed above in regard to your job performance?
Yes ☐ No ☐ Specify

## References:

1. Name Address Phone
2. Name Address Phone
3. Name Address Phone

May we contact the references listed above in regard to your job performance?
Yes ☐ No ☐ Specify

## Application:

Have you ever worked for us before? Yes ☐ No ☐ If yes, what position(s)?

Type of position(s) desired

1. 2. 3.

Date available to begin work

Please describe below why you would be an asset to this company if you were hired. List experience, skills, and training that qualify you for the applied position. Be specific.

*Equal Opportunity Employer*

## MANUFACTURING SYSTEMS
## UNIT D-2

## ASSIGNMENT SHEET #5 — INTERVIEW FOR A JOB IN THE CLASS MANUFACTURING COMPANY

Name ______________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Well-prepared | ____ |
| Acted properly | ____ |
| Answered questions appropriately | ____ |
| Followed up the interview | ____ |

Directions: The impression created by a job interview is usually the deciding factor in whether or not you will be employed by the company. The following guidelines will be useful for you to follow during your interview.

A. Prepare for the interview.

1. Wear appropriate clothing — Dress better than you would on a day at work.
2. Be well-groomed, clean, and neat.
3. Organize the materials you need to take to the interview.
4. Go alone. Do not take family or friends.
5. Do not be late.
6. Find out facts about the interviewer and business ahead of time.

B. Meet the receptionist with a smile, introduce yourself, state that you have an appointment, and wait patiently.

C. Conduct yourself appropriately during the interview.

1. Smile warmly.
2. Call the interviewer by Mr. or Mrs. (last name).
3. Introduce yourself and state the position you are applying for.
4. Shake hands firmly if it is offered.
5. Be seated only at the interviewer's invitation.
6. Sit still or stand erect.

## ASSIGNMENT SHEET #5

7. Do not smoke, chew gum or tobacco, or eat candy.

8. Do not place personal items on the interviewer's desk.

9. Look alert, interested, and enthusiastic.

D. Answer questions appropriately.

1. Let the interviewer take the lead in the conversation.

2. Do not interrupt.

3. Express yourself clearly and distinctly; avoid slang terms, swearing, and giggling.

4. Look directly at the interviewer.

5. Do not try to flatter the interviewer.

6. Do not talk about personal problems.

7. Have a resume available.

8. Answer questions honestly.

9. Be positive in all responses.

10. Show interest in the business; ask questions.

E. Close the interview properly.

1. Watch for signs that the interview is ending.

   Example: Shuffling papers, interviewer is moving around in the chair

2. Thank interviewer for his/her time.

3. If a handshake is offered, do so firmly.

F. Follow up the interview — Write a thank-you letter, call, or visit again to express further interest in the job.

## MANUFACTURING SYSTEMS
## UNIT D-2

## TEST

Name ______________________________ Score ________________

1. Match the terms on the right with their correct definitions.

_____a. Money, buildings, machinery, and investments that are used, or available, to make products or services

_____b. A business organization

_____c. Economic reward for filling the needs and wants of consumers; return received by a business after all operating expenses have been paid

_____d. Marketing-centered political/economic system which encourages as little government intervention and control as possible

_____e. Business which is the only producer of a good or service; one which has no competition

______f. French word meaning "enterpriser"; a person who owns his or her own business

1. Capital
2. Consumer
3. Enterprise
4. Entrepreneur
5. Free enterprise
6. Monopoly
7. Profit

2. Distinguish among the types of manufacturing systems by placing the following letters next to the correct descriptions:

- CUSTOM — Custom manufacturing
- INT — Intermittent manufacturing
- CONT — Continuous manufacturing

_____a. Companies involved in this area are often called job shops since they contract or take orders for specific jobs or quantities

_____b. Oldest type of manufacturing

_____c. Utilizes both automation and mechanization

_____d. Characterized by skilled craftsmen producing individual or limited quantity items

## TEST

3. Match the types of automated manufacturing on the right with the correct descriptions.

_____a. "Intelligent" automated machines controlled by computers

_____b. Integration of computers with design and manufacturing

_____c. Making sure that raw materials and purchased parts arrive at the factory just in time to be used on the production line

1. CAD/CAM
2. CIM
3. FMS
4. JIT
5. Robotics

4. State three criteria used in choosing an appropriate type of manufacturing system.

a. ____________________

b. ____________________

c. ____________________

5. Match the items needed by a manufacturing enterprise listed on the right with the correct descriptions.

_____a. All the physical things needed to convert the materials to a product; includes all utilities, energy resources, buildings, and equipment

_____b. People who perform the manufacturing operations

_____c. The money needed to start and maintain a manufacturing enterprise

1. Finance
2. Materials
3. Management
4. Labor
5. Facilities

6. State three functions of management.

a. ____________________

b. ____________________

c. ____________________

## TEST

7. Select from the following list the responsibilities of management by placing an "X" next to the correct responsibilities.

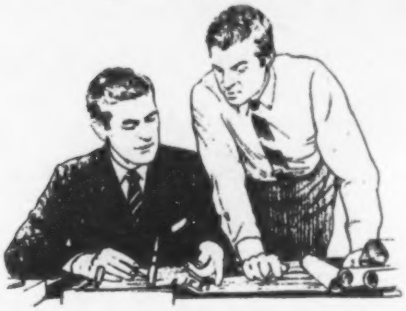
_____a. Satisfy the needs and wants of consumers

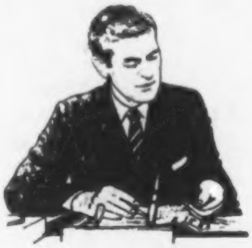
_____b. Make employees happy and wealthy

_____c. Protect company employees

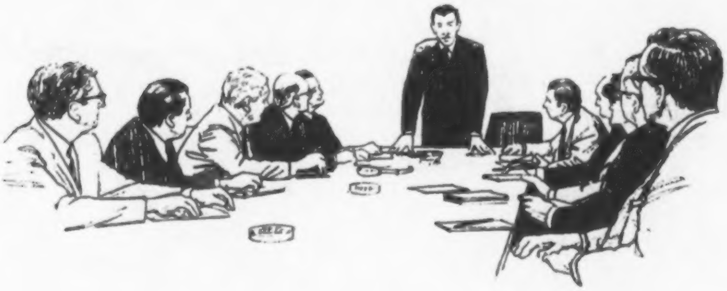
_____d. Make a profit for company owners

8. Identify the following forms of ownership of manufacturing enterprises.





a. ___________________________ b. ___________________________



c. ___________________________

9. Complete the following statements concerning the importance of the different forms of ownership in the United States by circling the correct words.

a. (Individual proprietorship, Corporations) account for over 75% of the products and services provided in the U.S.

b. (1, 2, 3) out of every 4 businesses are individual proprietorships.

## TEST

10. List three methods of obtaining capital resources.

 a. ____________________

 b. ____________________

 c. ____________________

11. State four attributes that an employer looks for in an employee.

 a. ____________________

 b. ____________________

 c. ____________________

 d. ____________________

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

12. Identify and gather information about two businesses in your community. (Assignment Sheet #1)

13. Determine ways to obtain capital resources for a class manufacturing company. (Assignment Sheet #2)

14. Write a resume. (Assignment Sheet #3)

15. Complete a job application for the class manufacturing company. (Assignment Sheet #4)

16. Interview for a job in the class manufacturing company. (Assignment Sheet #5)

## MANUFACTURING SYSTEMS
## UNIT D-2

## ANSWERS TO TEST

1. a. 1
   b. 3
   c. 7
   d. 5
   e. 6
   f. 4

2. a. INT
   b. CUSTOM
   c. CONT (or INT)
   d. CUSTOM

3. a. 5
   b. 1 or 2
   c. 4

4. Any three of the following:

   a. Volume (the quantity to be produced)
   b. Availability of necessary inputs (people, capital, materials, tools and machines)
   c. Type(s) of products to be made
   d. Life cycle or durability of a product
   e. Production philosophy of the organization

5. a. 5
   b. 4
   c. 1

6. Any three of the following:

   a. Planning
   b. Directing
   c. Controlling
   d. Organizing

7. a, c, d

8. a. Partnership
   b. Individual proprietorship
   c. Corporation

## ANSWERS TO TEST

9. a. Corporations
   b. 3

10. a. Private savings
    b. Loans
    c. Selling securities — stocks or bonds

11. Any four of the following:

    a. Enthusiasm and interest
    b. Dedication and dependability
    c. Alertness, quickness of mind (safety-minded)
    d. Honesty and integrity
    e. Desire to work
    f. Ability to work with others and to follow orders
    g. Desire to improve oneself
    h. Neat, clean appearance
    i. No evidence of drug or alcohol use affecting job performance
    j. Decision-making ability
    k. Problem-solving ability
    l. Competency in necessary skills

12.-16. Evaluated to the satisfaction of the instructor

## MANUFACTURING MATERIALS
## UNIT D-3

### UNIT OBJECTIVE

After completion of this unit, the student should be able to distinguish among the type and properties of manufacturing materials used by industry. Competencies will be demonstrated by completing the assignment sheets, lab activity sheet, and unit test with a minimum score of 85 percent.

### SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match common manufacturing materials with the correct descriptions.
2. Distinguish between the two major types of woods.
3. Select true statements concerning characteristics of woods.
4. Distinguish between the types of metals.
5. Select from a list the properties of metals.
6. Distinguish between the types of plastics.
7. Select from a list the properties of plastics.
8. List types of earth materials.
9. Select from a list the properties of earth materials.
10. Distinguish between types of composites.
11. Match general properties of materials with the correct descriptions.
12. Select true statements concerning considerations when selecting a material.
13. Test various properties of two samples of wood and record the results. (Assignment Sheet #1)
14. Identify a product that can be manufactured by your class company. (Assignment Sheet #2)
15. Sketch three views of the product selected by class for production. (Assignment Sheet #3)
16. Select materials needed for production of class product. (Assignment Sheet #4)
17. Construct and test a cellular structure. (Lab Activity Sheet #1)

## MANUFACTURING MATERIALS
## UNIT D-3

### SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher edition only and are designed to be used with the following objectives:

TM 1 — Common Manufacturing Materials — Objective 1

TM 2 — Types of Wood — Objective 2

TM 3 — Types of Metals — Objective 4

TM 4 — Types of Plastics — Objective 6

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information, assignment, and lab activity sheets.

F. Discuss information, assignment, and lab activity sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit.

1. Use Teacher Supplement #1 to present AIT video D-3. This video was developed by the Agency for Instructional Technology (AIT) and a consortium of states to accompany this publication. Contact your state supervisor of technology education for copies, or contact AIT directly for more information:

   Agency for Instructional Technology (AIT)
   Box A, Bloomington, IN 47402
   800-457-4509 or 812-339-2203

2. Use Teacher Supplements #2 and #3 to help students understand this unit's terminology. Make copies (fronts only) for your students. The answers are on the backs of the supplements.

3. Use Teacher Supplement #4 to build the structure tester needed for the lab activity.

4. Obtain and display samples of materials as they are presented and discussed.

5. Identify the various types of materials in products used daily.

## SUGGESTED ACTIVITIES

6. Conduct material testing on metals, plastics, etc.

7. Identify the various types of materials and their characteristics.

8. Discuss the cellular makeup of metals, wood, plastics, etc. Explain how this relates to their strength and weight.

9. Have students discuss in class their ideas of possible products that the class can make. (Assignment Sheet #2) Have them debate the pros and cons of each idea. Examples of products include interlocking puzzles, note holders, pen flashlights, fly swatters, or trivets. Involve students in the final decision.

10. After students decide on the product and the materials needed (Assignment Sheet #4), order any materials not on hand or assist students in ordering.

11. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Give test.

I. Evaluate test.

J. Reteach if necessary.

## REFERENCES USED IN DEVELOPING THIS UNIT

A. Feirer, John F. *Woodworking for Industry.* Peoria, IL: Bennett, 1979.

B. *Industrial Education: Materials & Processes,* C.B.I.E. Project. Topeka, KS: Kansas State Department of Education, 1972.

C. *Iowa High School Curriculum — Manufacturing.* Des Moines: Iowa State University, The State Department of Education, 1986.

D. *Manufacturing.* Stillwater, OK: Mid-America Vocational Curriculum Consortium, Inc., 1977.

E. *Secondary Exploration of Technology.* Topeka, KS: Pittsburg State University, The State Department of Education, 1974.

F. Tracy, George R. *Modern Physical Science.* New York: Holt, Rinehart, and Winston, 1979.

G. Walker, John R. *Modern Metalworking.* South Holland, IL: Goodheart-Wilcox Co., 1976.

H. *Missouri Introduction to Materials and Processing Technology Guide.* Columbia, MO: IML (Instructional Materials Laboratory), University of MO - Columbia 65202, 1989.

## SUGGESTED ACTIVITIES

## SUGGESTED SUPPLEMENTAL RESOURCES

A. Videos

1. *Manufacturing Systems Explained: Defining Inputs and Determining Resources.* Available from:

   Bergwall Productions, Inc.
   P.O. Box 238
   Garden City, NY 11530-0238
   800-645-3565

2. The following may be ordered from:

   Modern Talking Picture Service
   5000 Park Street North
   St. Petersburg, FL 33709
   813-541-5763

   a. *Aluminum Recycling*, 18 min.

   b. *Steel from Inland*, 28 min.

   c. *Product Research...Assuring the Future*, 10 min.

   d. *Design for Quality*, 15 min.

3. *Using and Evaluating Materials*, 13 min. Available from:

   Agency for Instructional Technology
   Box A
   Bloomington, IN 47402
   800-457-4509

B. Magazines and books

1. *Wood and Wood Products*
   Vance Publishing Corporation
   400 Knightsbridge Parkway
   Lincolnshire, IL 60069

2. *Technology of Industrial Materials* by H. C. Kazanas
   Glencoe-McGraw Hill
   Mission Hills, CA

# MANUFACTURING MATERIALS
# UNIT D-3

## TEACHER SUPPLEMENT #1—USING AIT VIDEO D-3

### Introduction and Program Summary (12:50)

This program presents the use, testing, and improvement of materials used in manufacturing. It discusses the origins, properties, and uses of five categories of materials, their usefulness for different products, and the importance to industry of testing properties of materials.

The program opens with images showing a man-powered aircraft, a bullet-proof vest, and students making various objects in a technology education class. The choice of the right materials has been of primary importance for each case. Wood, from trees, is readily available, renewable, and strong. It is useful for many kinds of construction. Metals, from mines, must be processed to be used, but they can be recycled. Their strength makes them suitable for many kinds of heavy construction. Earth materials include brick, ceramic tiles, limestone, and glass. These are hard and durable and do not conduct heat, making them suitable for insulation. Plastics are derived from oil. They are light, flexible, and can be either soft or hard; they do not conduct electricity, making them especially useful in electronics. Composites consist of two or more materials bonded together, such as concrete or fiberglass. Kevlar®, a new composite, is light, strong, and supple; it makes an excellent bullet-proof vest.

The program leads viewers to Battelle Laboratories, where industries send their products for testing. Credit cards are tested for strength, flexibility, and ability to withstand forgery. Running shoes are battered to test their strength and durability. In the Louisville Slugger factory and at a softball diamond, viewers are asked to compare the properties of wooden and aluminum bats. Which bat is better? In the future, cryogenics may become increasingly important in treating materials; subjecting them to extremely cold temperatures and then reheating them slowly makes them stronger and longer-lasting.

### Video Program Objectives

The video program will illustrate

- the origins and uses of five common manufacturing materials
- properties of manufacturing materials
- how some properties of materials are tested in industry
- that the properties of materials affect their use in making products

### Before the Program

1. Tell your students this lesson illustrates the use of different types of materials and the products made from them.

## TEACHER SUPPLEMENT #1

2. Ask students to name the materials used to produce some of the items in the classroom and laboratory. Ask why were these particular materials chosen, and tell them that one of the reasons a particular material is used is because of its particular properties. This video program will discuss this as well as other aspects of materials technology.

3. Tell students what they will be doing in the lab, and how the content of the video program will set the stage for the laboratory activity.

4. Tell students to note the following in the video program: five types of manufacturing materials—their origin, examples, and applications; the properties of materials which are tested in industry; choices which are made in selecting materials for manufacturing.

5. Tell students to listen for the following terms. (You might write them on the chalkboard.)

    plastics
    properties
    earth materials
    concrete
    foundry
    ceramic tile
    asbestos
    fiberglass
    composites
    glass
    aluminum
    Gossamer Albatross
    Kevlar®
    limestone
    conductors
    insulators
    recycling
    cryogenics

**After the Program: Questions for Discussion and Review**

1. What are the five major types of materials discussed in the video? What is their origin? (***wood****—comes from trees;* ***metals****—from ores in the ground and in the sea;* ***plastics****—most often made from oil;* ***earth materials****—come from the earth's crust;* ***composites****—man-made materials which combine some of the other materials)*

2. Why are different materials used in different applications? *(Properties of materials lend themselves to specific applications; plastics are used to enclose electronic equipment because it doesn't conduct electricity and protects users from shock.)*

3. What are some applications of materials illustrated in the video? *(wood for framing houses; ceramic tiles for the Space Shuttle's reentry from space; Kevlar® for bullet-proof vests, etc.)*

4. What properties would a material need to possess to be used for a football helmet? A cooking pot or container? A pillow? A ladder for working near electrical lines? Water skis? Handles on a cooking pan? *(****football helmet****—strength to withstand an impact;* ***cooking pot****—must be able to conduct heat;* ***pillow****—soft, cushiony, resilient;* ***ladder for working near electrical lines****—must be strong enough to support weight and be made of an insulator;* ***water skis****—should float in water and withstand the shock of hitting water;* ***handles on a cooking pan****—should not conduct heat)*

5. What are examples of composites? Of earth materials? *(****composites****—concrete, fiberglass, Kevlar®, plywood, particle board, carbide tools, graphite composites, etc.;* ***earth materials****—ceramic tile, glass, asbestos, diamonds, rock, plaster, clay, etc.)*

## TEACHER SUPPLEMENT #1

6. What are two reasons for using aluminum instead of steel for manufacturing soft drink cans? *(lighter in weight for shipping, and readily recyclable)*

7. What are examples of materials used on a limited basis because of environmental hazards? *(The video program example is asbestos, a cancer causing agent; others not mentioned include lead in indoor paints, mercury, and certain plastic foams [isocyanates] for house insulation which cause illness.)*

8. Could a human-powered plane have crossed the English Channel 30 years ago? *(No, materials that were light enough and strong enough to manufacture such a plane were not available.)*

## MANUFACTURING MATERIALS
## UNIT D-3

### TEACHER SUPPLEMENT #2—CROSSWORD PUZZLE

Name ______________________________ Date ____________________

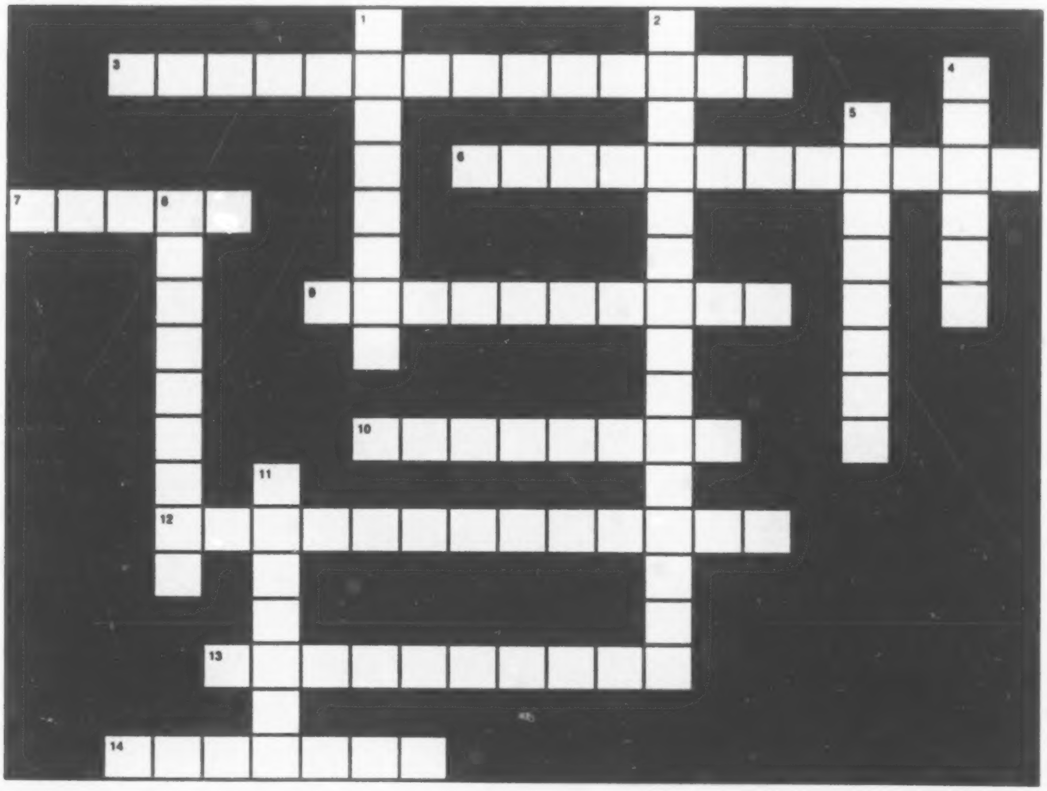
Directions: Use the clues below to solve the crossword puzzle.

ACROSS

3. Acrylic, vinyl, polyethylene, etc.
6. Ability to be hammered, but still be strong
7. Materials that come from trees
9. Metals that do not contain any iron
10. Oak, walnut, maple, etc.
12. Plastics that cannot be reheated or reshaped
13. Two distinct solids that are bonded together
14. Property of a twisting force

DOWN

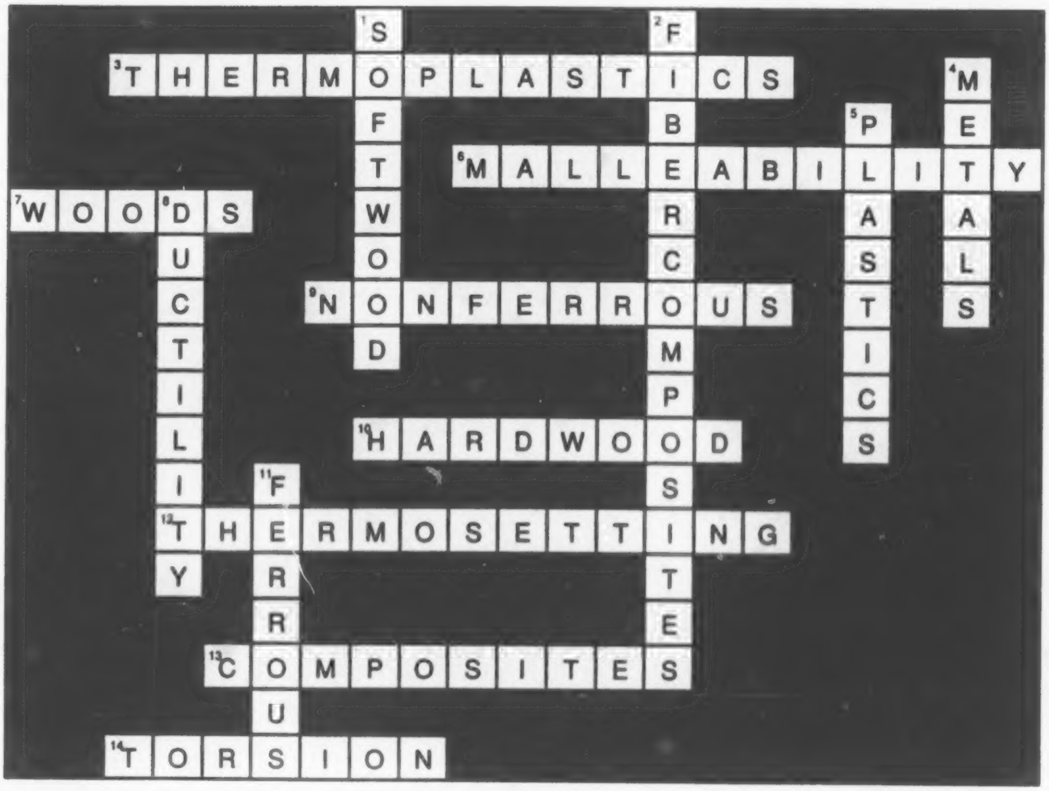
1. Comes from coniferous trees
2. Fibers form a matrix to reinforce material
4. Ferrous and nonferrous
5. Primarily made from petroleum products
8. Ability to be bent, twisted, or changed in shape
11. Metals that contain iron



*Duplication Permitted*

## TEACHER SUPPLEMENT #2

## CROSSWORD PUZZLE ANSWER KEY


1 SOFTWOOD
2 FIBERCOMPOSITES
3 THERMOPLASTICS
4 METALS
5 PLASTICS
6 MALLEABILITY
7 WOODS
8 DUCTILITY
9 NONFERROUS
10 HARDWOOD
11 FERROUS
12 THERMOSETTING
13 COMPOSITES
14 TORSION

## MANUFACTURING MATERIALS
## UNIT D-3

## TEACHER SUPPLEMENT #3—WORD SCRAMBLE

Name ______________________________ Date ____________________

Directions: Unscramble the letters to form words we are studying. Write the words in the spaces on the right.

1. TNROIOS _ _ _ _ _ _ _
2. EORSCOMESIPBTFI _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
3. MASLTE _ _ _ _ _ _
4. PCTHEIMOSSALRT _ _ _ _ _ _ _ _ _ _ _ _ _ _
5. DANSSERH _ _ _ _ _ _ _ _
6. SEONURORNF _ _ _ _ _ _ _ _ _ _
7. ORDHDAWO _ _ _ _ _ _ _ _
8. YBAMEILTILAL _ _ _ _ _ _ _ _ _ _ _ _
9. TTYUIDICL _ _ _ _ _ _ _ _ _
10. DWTSOOFO _ _ _ _ _ _ _ _
11. ROFSRUE _ _ _ _ _ _ _
12. WSODO _ _ _ _ _
13. PTSEMIOSOC _ _ _ _ _ _ _ _ _ _
14. CITSLPAS _ _ _ _ _ _ _ _
15. TNRITESEOTHGM _ _ _ _ _ _ _ _ _ _ _ _ _

## TEACHER SUPPLEMENT #3

## WORD SCRAMBLE ANSWER KEY

| | | |
|---|---|---|
| 1. | TNROIOS | TORSION |
| 2. | EORSCOMESIPBTFI | FIBER COMPOSITES |
| 3. | MASLTE | METALS |
| 4. | PCTHEIMOSSALRT | THERMOPLASTICS |
| 5. | DANSSERH | HARDNESS |
| 6. | SEONURORNF | NONFERROUS |
| 7. | ORDHDAWO | HARDWOOD |
| 8. | YBAMEILTILAL | MALLEABILITY |
| 9. | TTYUIDICL | DUCTILITY |
| 10. | DWTSOOFO | SOFTWOOD |
| 11. | ROFSRUE | FERROUS |
| 12. | WSODO | WOODS |
| 13. | PTSEMIOSOC | COMPOSITES |
| 14. | CITSLPAS | PLASTICS |
| 15. | TNRITESEOTHGM | THERMOSETTING |

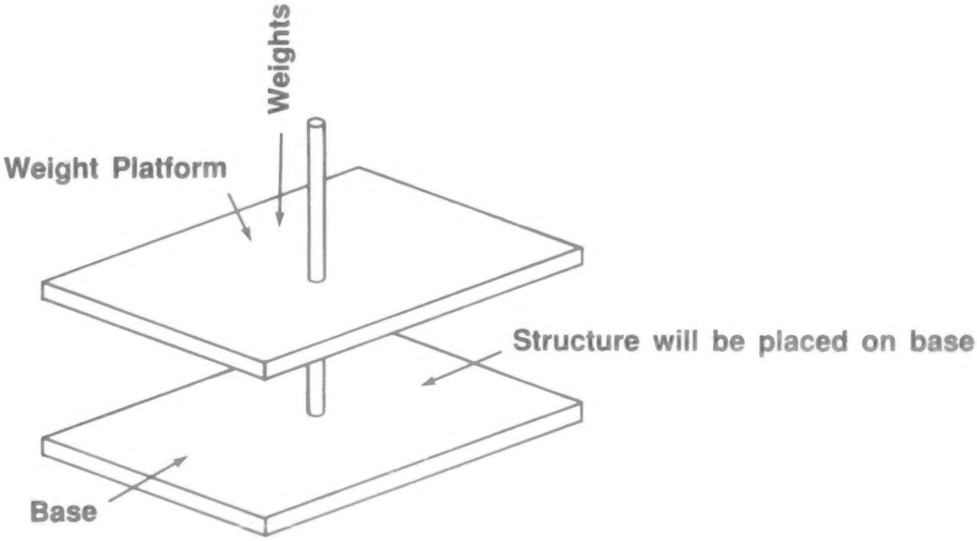
## MANUFACTURING MATERIALS
## UNIT D-3

### TEACHER SUPPLEMENT #4—STRUCTURE TESTER

A. Materials needed:

1. 1/4" x 1′ x 1′ hardboard (paneling)
2. 3/4" x 18" x 18" plywood
3. 3/4" x 36" dowel rod
4. Variety of dumbbell weights

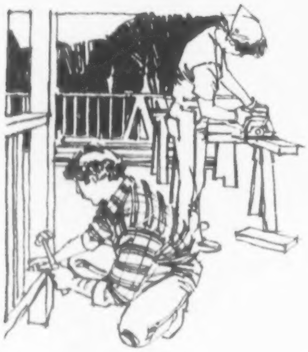
B. The finished tester should look similar to the following:



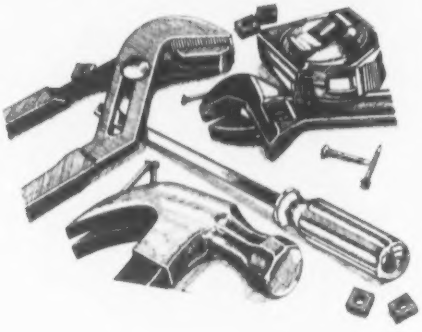
C. Testing procedure:

1. Before testing a structure, students should have calculated the area of their structure.
2. Place the structure on the base with the rod going through the structure.
3. Place the weight platform on top of the structure.
4. Place weights on top of the weight platform.
5. Immediately after significant structure breakdown, total the weight held and calculate the efficiency.

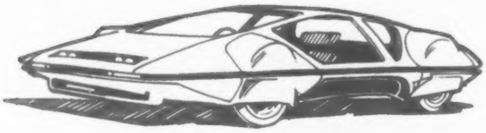
# Common Manufacturing Materials



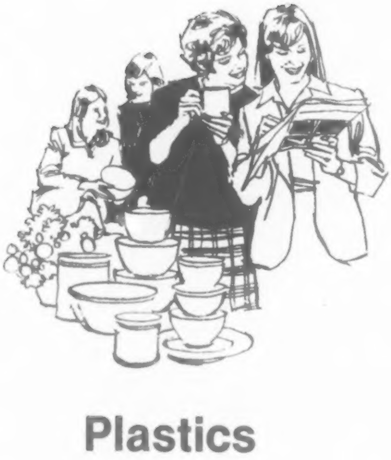
**Woods**



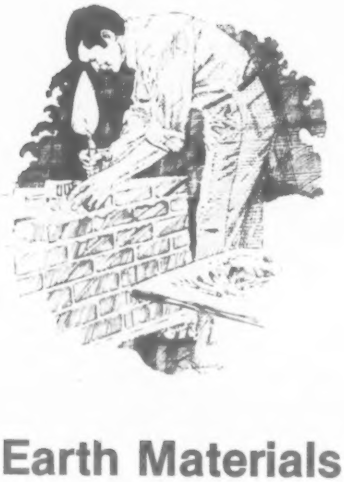
**Metals**



**Composites**

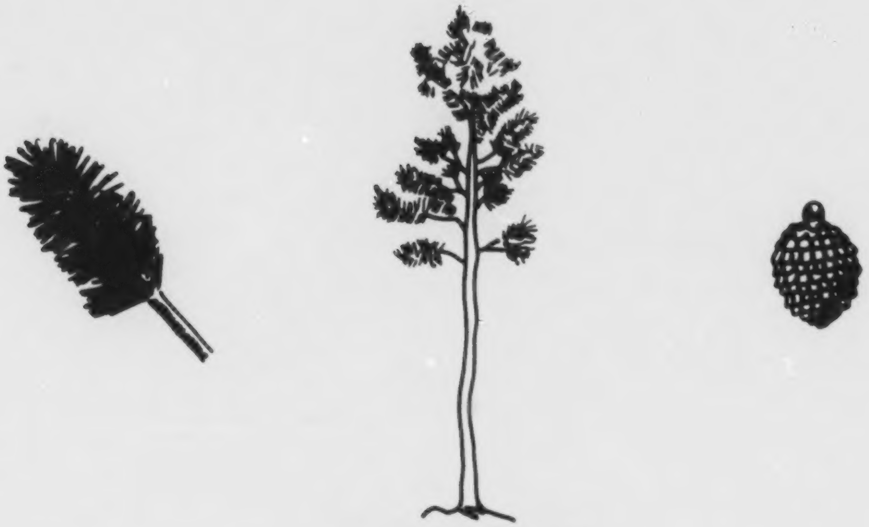


**Plastics**



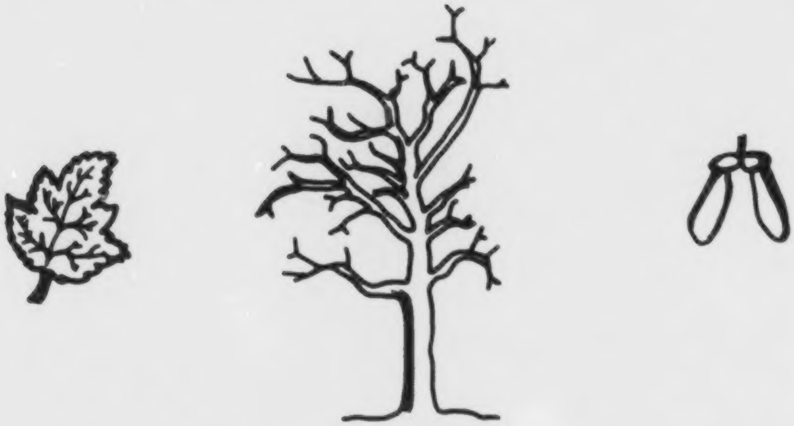
**Earth Materials**

# Types of Wood



## Soft Wood

From Coniferous Trees

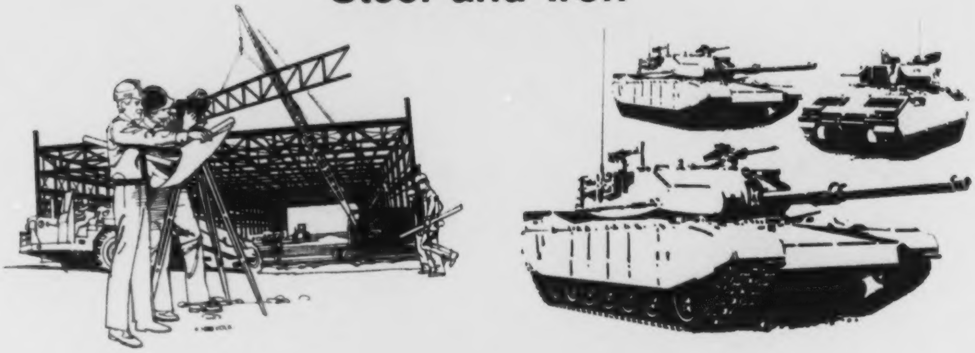


## Hard Wood

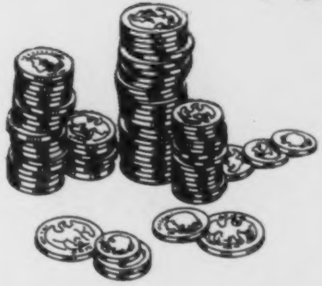
From Deciduous Trees

# Types of Metals

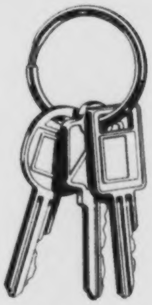
Steel and Iron



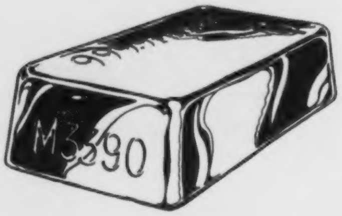
## Ferrous Metals



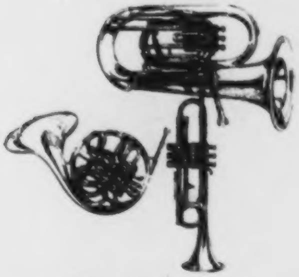
Silver, Nickel, Copper



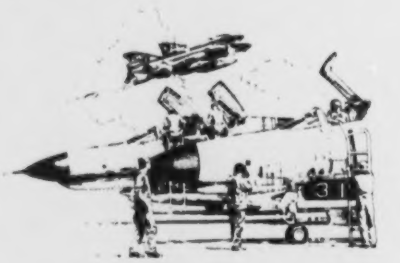
Aluminum



Gold



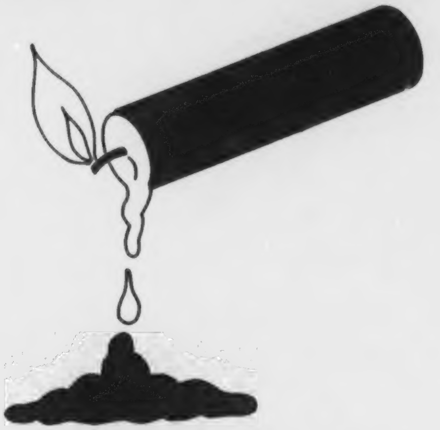
Brass



Aluminum and Space Age Metals

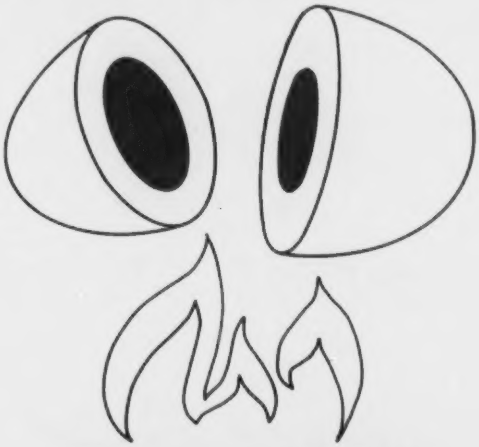
## Nonferrous Metals

# Types of Plastics



## Thermoplastic

These plastics become soft when exposed to sufficient heat and harden when cooled. Process can be repeated.



## Thermosetting

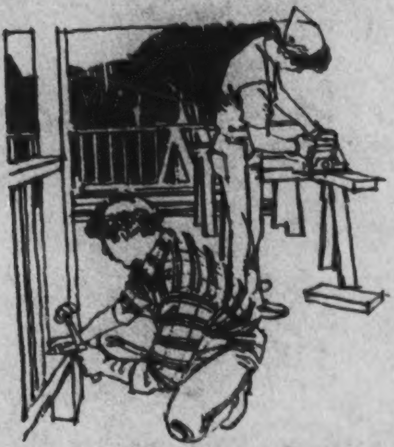
These plastics become set into permanent shapes when heat and pressure are applied to them during the forming process. Reheating will not soften these materials.

# MANUFACTURING MATERIALS
## UNIT D-3

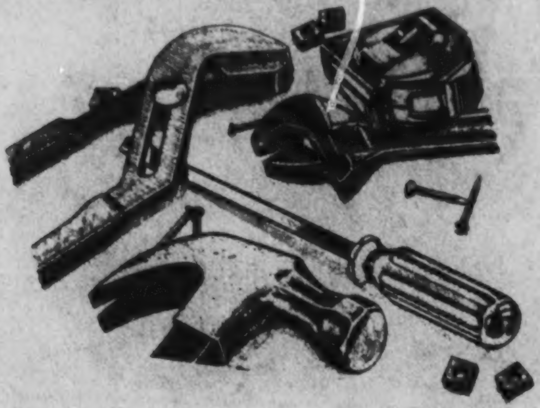
## INFORMATION SHEET

I. Common manufacturing materials

A. Woods —Materials that are durable, have a medium hardness, poor electrical and heat conductivity, lightweight, and come from trees

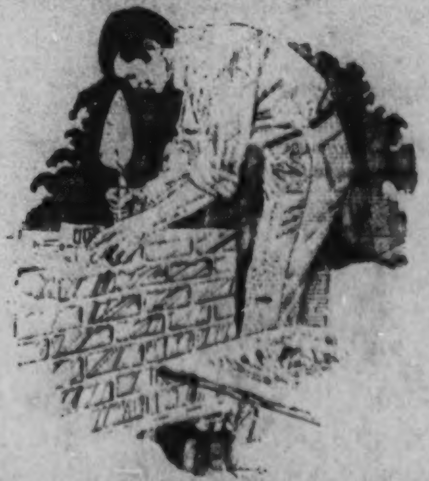


B. Metals — Materials that have a high melting point, good conductivity, durable, medium to high hardness, and often are shiny

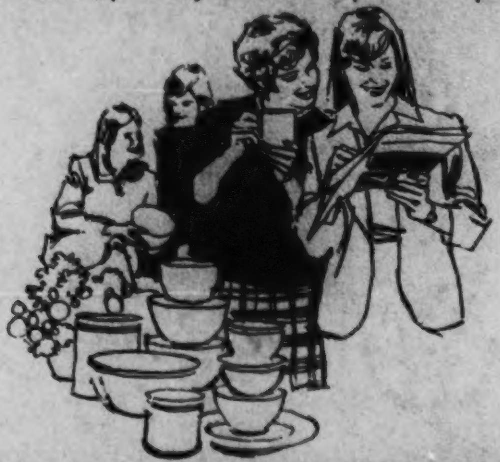


## INFORMATION SHEET

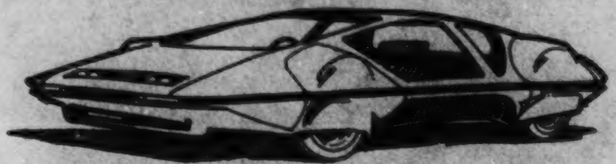
C. Earth materials — Materials produced from minerals which are extracted from the earth's crust



D. Plastics — Man-made materials that can easily be molded, cast, or drawn into objects or filaments; primarily made from petroleum products



E. Composites — Materials that consist of two distinct solids bonded together

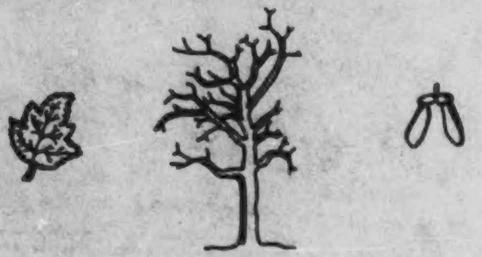


## INFORMATION SHEET

II. **Types of wood**

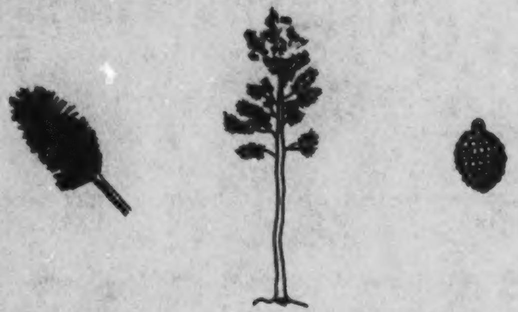
A. Hard wood — Comes from deciduous (broadleaf) trees

Examples: Oak, walnut, pecan, maple, cherry



B. Soft wood — Comes from coniferous (needleleaf, cone-bearing) trees

Examples: Pine, fir, spruce



(NOTE: This classification as hard or soft does not always indicate the degree of hardness of the wood. Some soft woods such as firs are harder than some hard woods such as fruit trees.)

III. **Characteristics of wood**

A. Wood is relatively lightweight. This is explained by the fact that approximately half its volume is made of hollow cells. Wood has been referred to as an elastic honeycomb.

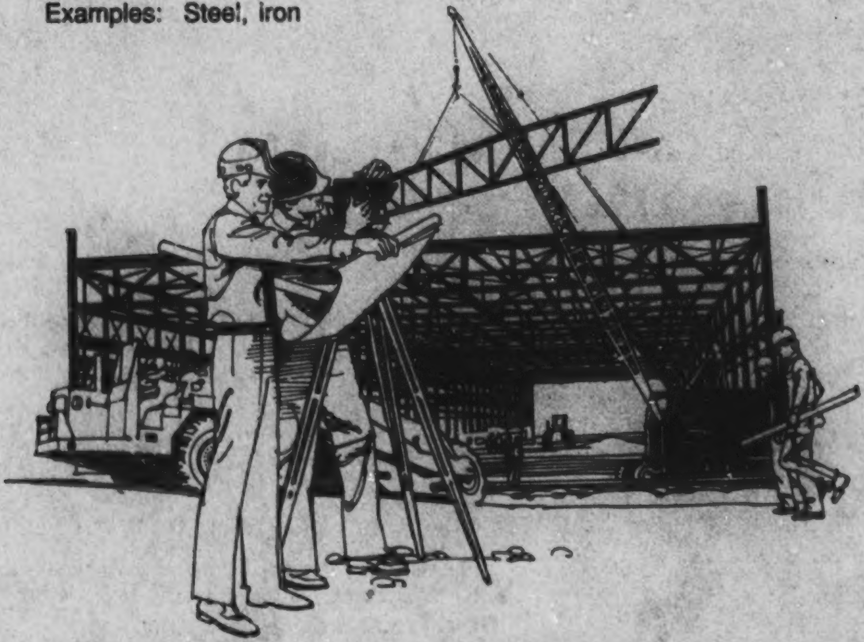
B. Every piece of wood is different from every other although most wood is readily recognized as wood. This is because each piece comes from a living plant that differs from other plants and species or in growing conditions.

## INFORMATION SHEET

IV. **Types of metals**

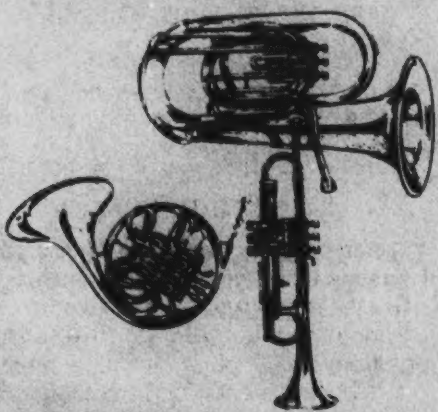
A. Ferrous metals — Alloys which contain iron as a major element in their composition

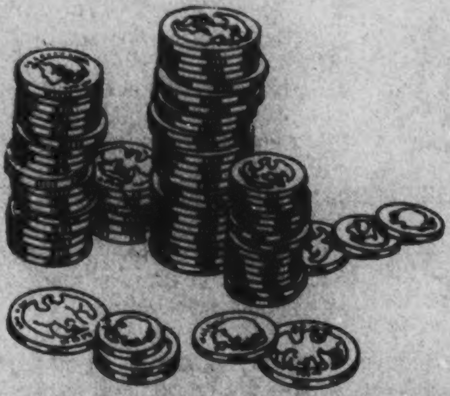
Examples: Steel, iron



B. Nonferrous metals — Metals which contain no iron except in very small quantities as impurities

Examples: Aluminum, brass, tin, copper, lead, gold, silver





(NOTE: Ferrous and nonferrous metals could also be classified as base metals containing only one metal or as alloys which have several metals fused or blended together.)

## INFORMATION SHEET

V. **Properties of metals**

   A. Opaque

   B. Reflective when polished

   C. Conduct heat

   D. Conduct electricity

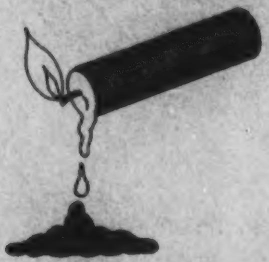
   E. Expand when heated

   F. Contract when cooled

VI. **Types of plastics**

   A. Thermoplastics — Are heated, shaped, and cooled, and can be reheated and reshaped again and again

   Examples: Acrylic, vinyl, polyethylene

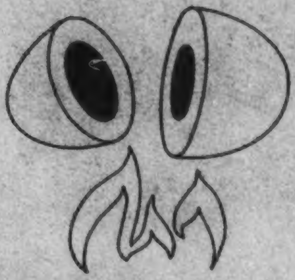


**Thermoplastic**

**These plastics become soft when exposed to sufficient heat and harden when cooled. Process can be repeated.**

   B. Thermosetting — Are heated, shaped, and cooled, but can not be reheated or reshaped; are set by heat

   Examples: Polyester, epoxy, silicone



**Thermosetting**

**These plastics become set into permanent shapes when heat and pressure are applied to them during the forming process. Reheating will not soften these materials.**

## INFORMATION SHEET

### VII. Properties of plastics

(NOTE: The properties of plastics vary greatly from family to family. A family of plastics is a group which is chemically the same.)

- A. Low melting points
- B. Flexible
- C. Poor conductors (good insulators)
- D. Durable
- E. Medium hardness
- F. Available in any color

### VIII. Types of earth materials

- A. Bricks
- B. Clay-based ceramics

  Examples: Ceramic tile, porcelain sinks, china
- C. Glass
- D. Cement
- E. Rock and stone

### IX. Properties of earth materials

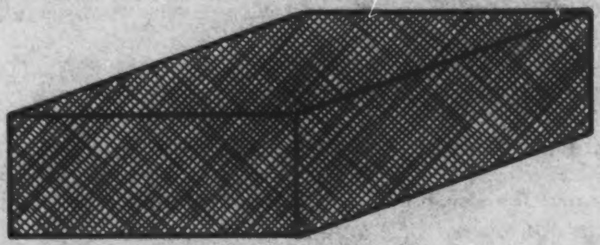
- A. Hard
- B. Poor conductors (good insulators)
- C. Heavy
- D. Inflexible
- E. High melting points

## INFORMATION SHEET

### X. Types of composites

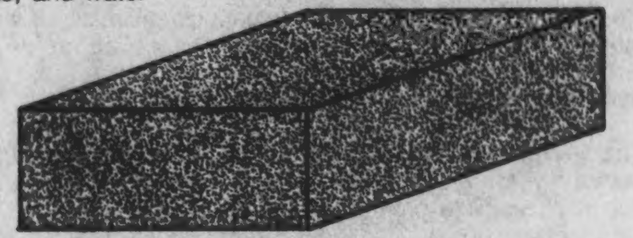
A. Fiber composites — Fibers form a matrix to reinforce a material

Example: Fiberglass — Glass fibers reinforce plastic to make a very strong material



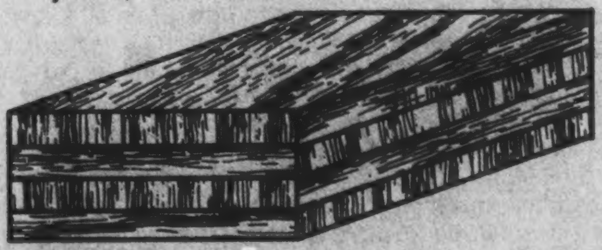
B. Particle composites — Particles are held in a matrix and both form a stronger unit

Examples: Particle board—wood chips and glue, concrete—cement, aggregate, and water



C. Laminate composites — Layers are glued together

Examples: Plywood, laminated beams



### XI. General properties of materials

(NOTE: Materials useful for a specific manufacturing purpose need to have certain properties that fit that purpose.)

A. Hardness — Resistance to penetration or indentation

B. Tensile strength — Ability to withstand a pulling force

## INFORMATION SHEET

C. Compression strength — Ability to withstand crushing force

D. Shear strength — Ability to resist sliding of one surface over another

E. Torsion strength — Ability to withstand twisting force

F. Ductility — Ability to be bent, twisted, stretched, or changed in shape

G. Malleability — Ability to be hammered, rolled, or compressed into a different shape and remain as strong as its original shape

H. Thermal conductivity — Ability to conduct (carry) heat

I. Thermal expansion — Amount that material expands (enlarges) when subjected to heat or contracts when cooled

J. Chemical properties — Reactions or resistance to various chemicals (such as acids, water, oxygen)

K. Electrical conductivity — Ability to conduct (carry) electrical current

(NOTE: A material that readily conducts electricity is called a conductor. A material that will not conduct electricity is called an insulator.)

### XII. Considerations when selecting a material

A. The first step in the selection process is to determine the properties that are necessary for the material to be useful for a specific application. Some questions that the product designer may ask are:

1. Will extreme temperature be likely?
2. Will the material be subjected to abrasive forces?
3. Will the material be exposed to solvents?
4. Will the material be subjected to heavy weights, impacts, or sharp objects?
5. Will the material come into contact with moisture?

B. Once these questions and others are answered, a material with the desired properties can be selected. Many times more than one material is suitable.

(NOTE: Occasionally materials must be made or created to meet a specific need such as many of the space vehicle materials.)

C. Once the suitable material(s) have been identified, an analysis of the availability and cost must be made. This will allow the designer to select between several appropriate methods or terminate the project.

## MANUFACTURING MATERIALS
## UNIT D-3

### ASSIGNMENT SHEET #1—TEST VARIOUS PROPERTIES OF TWO SAMPLES OF WOOD AND RECORD THE RESULTS

Name ______________________ Overall Rating __________

| EVALUATION CRITERIA | RATING |
|---|---|
| Tests were conducted appropriately | ______ |
| Conclusions were correct | ______ |
| Assignment is neat and completed on time | ______ |

You will be given two samples of wood. Once these have been obtained, follow the instructions for each of the following tests.

1. Use a brace and bit to drill holes in both samples. Which sample was easier to drill? ______________________

2. Use a wood rasp to file each sample. Which sample provided the better result?

   ______________________

3. Use a knife to carve small amounts of each sample. Which sample provided the better result? ______________________

4. Use a hammer to drive a small nail into both samples. Which sample was easier to nail? ______________________

5. What conclusions can you draw about Sample A and Sample B? Discuss below.

   ______________________

   ______________________

   ______________________

   ______________________

   ______________________

   ______________________

   ______________________

   ______________________

## MANUFACTURING MATERIALS
## UNIT D-3

### ASSIGNMENT SHEET #2—IDENTIFY A PRODUCT THAT CAN BE MANUFACTURED BY YOUR CLASS COMPANY

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Product identified meets criteria | ______ |
| Assignment is neat and completed on time | ______ |

1. Identify one product that would be appropriate for mass production in your laboratory.
2. Make certain that the following criteria are met:
   a. The cost of materials is not excessive.
   b. The manufacturing operations can be performed in the laboratory.
   c. The operations are not overly complex.
   d. The product is sellable.
   e. It is something that your classmates would be interested in producing.
3. Describe the product below and state your reasons for selecting it. ____________

________________________________________

________________________________________

________________________________________

________________________________________

## MANUFACTURING MATERIALS
## UNIT D-3

## ASSIGNMENT SHEET #3—SKETCH THREE VIEWS OF THE PRODUCT SELECTED BY CLASS COMPANY FOR PRODUCTION

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Preliminary sketches adequately show the product | _____ |
| Final sketches are appropriately drawn | _____ |
| Final sketches are complete | _____ |
| Assignment is neat and completed on time | _____ |

1. Draw preliminary sketches of the product selected by the class company for production.

   (NOTE: These are similar to thumbnail sketches, and are used to generate ideas for the product.)

## ASSIGNMENT SHEET #3

2. Draw final sketches of the product that the class company will produce. These sketches should include view names, dimensions, and product name.

## MANUFACTURING MATERIALS
## UNIT D-3

### ASSIGNMENT SHEET #4—SELECT MATERIALS NEEDED FOR PRODUCTION OF CLASS PRODUCT

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Materials listed are appropriate | ______ |
| Reasons for selection are appropriate | ______ |
| Assignment is neat and completed on time | ______ |

1. List the materials that are available for making the class manufacturing product.

______________________________________________________________

______________________________________________________________

______________________________________________________________

2. Select from the above list the materials that are needed for various parts of the class manufacturing product.

| | Part Name | Material |
|---|---|---|
| a. | ____________________ | ____________________ |
| b. | ____________________ | ____________________ |
| c. | ____________________ | ____________________ |
| d. | ____________________ | ____________________ |
| e. | ____________________ | ____________________ |
| f. | ____________________ | ____________________ |

## ASSIGNMENT SHEET #4

3. Give reasons for your selection of materials.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

f. ____________________

(NOTE: The selected materials need to be ordered at this time.)

## MANUFACTURING MATERIALS
## UNIT D-3

### LAB ACTIVITY SHEET #1—CONSTRUCT AND TEST A CELLULAR STRUCTURE

Name ______________________________ Overall Rating ______________

| EVALUATION CRITERIA | RATING |
|---|---|
| Structure built correctly | ______ |
| Structure tested correctly | ______ |
| Stress calculated correctly | ______ |

Introduction: Why is a piece of wood that weighs the same as a piece of metal stronger than the metal? Every material has its own cellular makeup. This activity is designed to introduce you to the concepts of material science through lab construction of a cellular structure. Upon completion of the cellular structure, you are to test the structures to determine which structure will support the most weight.

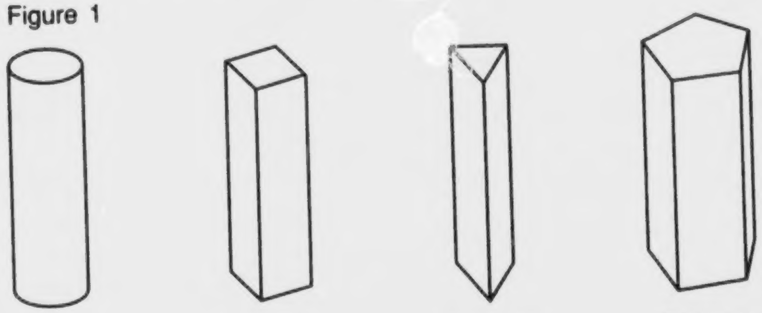
A. Materials needed:

- 1 sheet of paper (8½ x 11)
- Clear Tape
- Rulers
- Ink pens
- Scissors
- Weights
- Scales

B. Procedure: Cellular Structure Design

1. Select the basic form for the cellular structure.

Figure 1



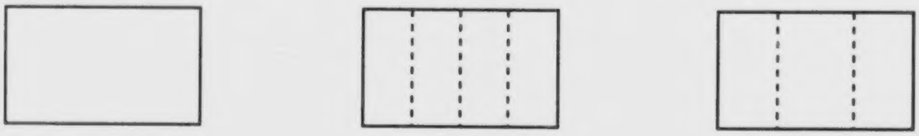
Circle Square Triangle Pentagon

## LAB ACTIVITY SHEET #1

2. Determine the size of each base structure and develop a pattern.

   (NOTE: Each material structure can be made from only one sheet of paper.)

   Figure 2



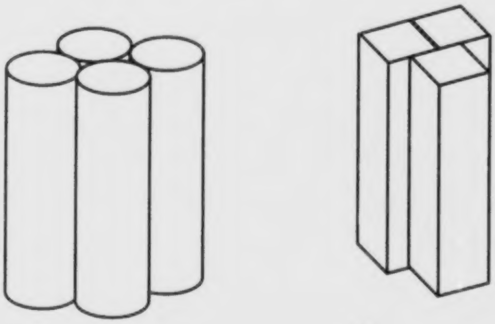
Cylinder Square Triangle

3. Use the pattern to develop the base structure using the remainder of the paper.

   (NOTE: Clear tape cannot be used to add strength to the structure. It is used only to hold the structure together.)

4. Assemble the base structure to form one large cellular structure.

   Figure 3



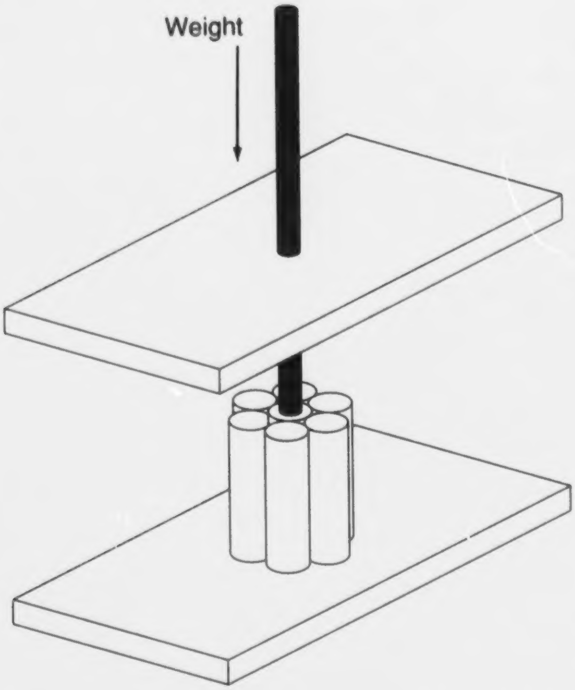
5. Calculate the surface area of your structure.

   Area = Length × Width (in inches)

## LAB ACTIVITY SHEET #1

6. Place the structure on the structure tester provided by your instructor and add weights until the structure collapses.

Figure 4



7. Calculate the stress according to the following formula using the surface area and the supported weight.

F (force) ------> stated in lbs<br>
STRESS = -----------<br>
A (area) -------> stated in sq inch

## MANUFACTURING MATERIALS
## UNIT D-3

### TEST

Name ______________________________ Score ____________________

1. Match the common manufacturing materials on the right with the correct descriptions.

_____a. Man-made materials that can easily be molded, cast, or drawn into objects or filaments; primarily made from petroleum products

_____b. Materials that have a high melting point, good conductivity, durable, medium to high hardiness, and often are shiny

_____c. Materials that consist of two distinct solids bonded together

_____d. Materials produced from minerals which are extracted from the earth's crust

_____e. Materials that are durable, have a medium hardness, poor electrical and heat conductivity, lightweight, and come from trees

1. Woods
2. Metals
3. Plastics
4. Earth materials
5. Composites

2. Distinguish between the two major types of woods by placing the following letters next to the correct descriptions:

- H — Hard wood
- S — Soft wood

_____a. Comes from coniferous trees

_____b. Comes from deciduous trees

3. Select true statements concerning characteristics of wood by placing an "X" next to the true statements.

_____a. Wood is relatively lightweight.

_____b. Every piece of wood is the same.

## TEST

4. Distinguish between the types of metals by placing an "X" next to the description of ferrous metals.

______a. Metals which contain no iron

______b. Alloys which contain iron as a major element in their composition

5. Select from the following list the correct characteristics of metals by placing an "X" in the appropriate blanks.

______a. Reflective when polished

______b. Expand when cooled

______c. Conduct electricity

______d. Transparent

6. Distinguish between the two types of plastics by placing a "TP" next to the description of thermoplastics and a "TS" next to the description of thermosetting plastics.

______a. Can not be reheated and reshaped

______b. Can be reheated and reshaped

7. Select from the following list the correct properties of plastics by placing an "X" in the appropriate blanks.

______a. Durable

______b. Delicate

______c. Good conductors

______d. High melting points

______e. Low melting points

______f. Poor conductors

______g. Flexible

______h. Inflexible

8. List three types of earth materials.

a. ____________________________

b. ____________________________

c. ____________________________

## TEST

9. Select from the following list the correct properties of earth materials by placing an "X" in the appropriate blanks.

______a. Good conductors

______b. Poor conductors

______c. High melting points

______d. Low melting points

______e. Hard

______f. Soft

______g. Flexible

______h. Inflexible

10. Distinguish between the types of composites by placing the following letters in the appropriate blanks.

- F — Fiber composites
- P — Particle composites
- L — Laminate composites

______a. An example is plywood.

______b. An example is fiberglass.

______c. An example is concrete.

11. Match general properties of materials on the right with the correct descriptions.

______a. Ability to resist sliding of one surface over another

______b. Ability to withstand crushing force

______c. Ability to carry heat

______d. Resistance to penetration or indentation

______e. Ability to withstand a pulling force

______f. Ability to be bent, twisted, stretched, or changed in shape

______g. Ability to be hammered, rolled, or compressed into a different shape and remain as strong as its original shape

1. Hardness
2. Tensile strength
3. Compression strength
4. Shear strength
5. Torsion strength
6. Ductility
7. Malleability
8. Thermal conductivity

## TEST

12. Select true statements concerning considerations when selecting a material by placing an "X" next to the true statements.

______a. The first step in the selection process is to determine the properties that are necessary for the material to be useful for a specific application.

______b. The first step in the selection process should be to determine cost.

______c. Many times, more than one material is suitable.

______d. Once suitable material(s) have been identified, an analysis of the availability and cost must be done.

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

13. Test various properties of two samples of wood and record the results. (Assignment Sheet #1)

14. Identify a product that can be manufactured by your class company. (Assignment Sheet #2)

15. Sketch three views of the product selected by class for production. (Assignment Sheet #3)

16. Select materials needed for production of class product. (Assignment Sheet #4)

17. Construct and test a cellular structure. (Lab Activity Sheet #1)

# MANUFACTURING MATERIALS
## UNIT D-3

## ANSWERS TO TEST

1. a. 3
   b. 2
   c. 5
   d. 4
   e. 1

2. a. S
   b. H

3. a

4. b

5. a, c

6. a. TS
   b. TP

7. a, e, f, g

8. Any three of the following:

   a. Bricks
   b. Clay-based ceramics
   c. Glass
   d. Cement
   e. Rock and stone

9. b, c, e, h

10. a. L
    b. F
    c. P

11. a. 4
    b. 3
    c. 8
    d. 1
    e. 2
    f. 6
    g. 7

## ANSWERS TO TEST

12. a, c, d

13.-17. Evaluated to the satisfaction of the instructor

# MANUFACTURING PROCESSES
## UNIT D-4

## UNIT OBJECTIVE

After completion of this unit, the student should be able to identify and explain the major types of manufacturing processes. Competencies will be demonstrated by completing the assignment sheets and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to manufacturing processes with the correct definitions.
2. Classify operations as pre-processing, processing, or post-processing.
3. Distinguish between primary and secondary manufacturing processes.
4. Distinguish between the major types of separating processes.
5. Select from a list the elements of the forming process.
6. Arrange in order the steps in the casting process.
7. Distinguish between the types of conditioning processes.
8. Complete statements concerning assembly processes.
9. Distinguish between the major finishing operations.
10. Select true statements concerning general safety rules.
11. Identify the manufacturing processes needed to make class manufacturing company's product. (Assignment Sheet #1)
12. Identify tools and machines needed to make class manufacturing company's product. (Assignment Sheet #2)
13. Subscribe to a safety pledge. (Assignment Sheet #3)

## MANUFACTURING PROCESSES
## UNIT D-4

### SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher edition only and are designed to be used with the following objectives:

TM 1 — Operations in Processing Technology — Objective 2

TM 2 — Primary Manufacturing Processes — Objective 3A

TM 3 and 4 — Secondary Manufacturing Processes — Objective 3B

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. Use Teacher Supplement #1 to present AIT video D-4. This video was developed by the Agency for Instructional Technology (AIT) and a consortium of states to accompany this publication. Contact your state supervisor of technology education for copies, or contact AIT directly for more information:

   Agency for Instructional Technology (AIT)
   Box A, Bloomington, IN 47402
   800-457-4509 or 812-339-2203

2. Use Teacher Supplements #2 and #3 to help students understand this unit's terminology. Make copies (fronts only) for your students. The answers are on the backs of the supplements.

3. Take a field trip to a local manufacturing company to allow students to view a manufacturing organization at work.

## SUGGESTED ACTIVITIES

4. Have students discuss conditioning operations that are performed in or around the home.

   Examples: Tilling soil, watering plants, baking cakes, adding fabric softener to clothes, etc.

5. Discuss all machines and tools to be used in this unit. Demonstrate their correct uses and safety considerations.

6. Have students demonstrate the operation of all equipment in the lab that they will be using as safety checks.

7. Demonstrate the operation of a CNC lathe.

8. Several products could be made by the class as time allows which will demonstrate different manufacturing processes. Examples are plastic trivets using a casting process or many wood products that require separating, assembling, and finishing processes. These would be supplemental activities, not the class manufacturing product that will be produced and finished in the next unit.

9. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Give test.

I. Evaluate test.

J. Reteach if necessary.

## REFERENCES USED IN DEVELOPING THIS UNIT

A. Feirer, John F. *Woodworking for Industry.* Peoria, IL: Bennett, 1979.

B. *Industrial Education: Materials and Processes*, C.B.I.E. Project. Topeka: Kansas State Department of Education, 1972.

C. *Iowa High School Curriculum — Manufacturing.* Des Moines: Iowa State University, State Department of Education, 1986.

D. *Manufacturing.* Stillwater, OK: Mid-America Vocational Curriculum Consortium, Inc., 1977.

E. *New Jersey Industrial Arts Education Safety Guide.* Rutgers University, 1983.

F. Sinn, John W. *Manufacturing Technology: Teacher's Handbook.* Bismarck, ND: North Dakota State Board for Vocational Education, 1983.

G. *Secondary Exploration of Technology.* Topeka: Kansas State College of Pittsburg, State Department of Education, 1974.

## SUGGESTED ACTIVITIES

H. Walker, John R., *Modern Metalworking*. South Holland, IL: Goodheart-Wilcox Co., 1976.

I. Wright, R. Thomas and Richard M. Henak. *Exploring Production.* South Holland, IL: Goodheart-Wilcox Co., 1985.

J. Komacek, Stanley, Ann E. Lawson, and Andrew C. Horton. *Manufacturing Technology.* Albany, NY: Delmar Publishers, Inc., 1990.

K. Fales, James F., et. al. *Manufacturing: A Basic Text.* Mission Hills, CA: Glencoe/McGraw-Hill, 1986.

L. Wright, R. Thomas. *Manufacturing: Material Processing, Management, Careers.* South Holland, IL: The Goodheart-Willcox Company, Inc., 1984.

M. Jambro, Donald J. *Introduction to Manufacturing.* Albany, NY: Delmar Publishers, Inc., 1982.

N. *Missouri Introduction to Materials and Processing Technology Guide.* Columbia, MO: IML (Instructional Materials Laboratory), University of MO — Columbia 65202, 1989.

## SUGGESTED SUPPLEMENTAL RESOURCES

A. Films

1. *Basic Elements of Production* (13 min.)

   University of Michigan
   Audio-Visual Education Center
   Ann Arbor, MI 48106

2. *Conserving a Heritage* (16 min.)

   Wisconsin Petroleum Council
   25 West Main Street
   Madison, WI 53703

3. *Factory: How a Product Is Made* (14 min.)

   University of Michigan
   Audio-Visual Education Center
   Ann Arbor, MI 48106

4. *Functions of Industry and You*

   University of Illinois
   Visual Aids Service
   Champaign, IL 61820

## SUGGESTED ACTIVITIES

5. *For Beauty and Use* (13 min.)

   National Association of Manufacturers
   227 Park Avenue
   New York, NY 10017

B. Videos:

1. The following videotapes are available from:

   Bergwall Productions, Inc.
   P.O. Box 238
   Garden City, NY 11530-0238
   800-645-3565

   a. *Manufacturing Systems Explained: Processes of Manufacturing*

   b. *Manufacturing Systems Technology: Basic Processes*

2. The following videos may be ordered from:

   Modern Talking Picture Service
   5000 Park Street North
   St. Petersburg, FL 33709-9989
   813-541-5763

   a. *Forging: The Pivotal Industry*, 28 min.

   b. *Extrusion: The Process of Choice*, 10 min.

   c. *Machine Tool Careers...Meeting Tomorrow's Challenge*, 28 min.

3. *Manufacturing Processes*, 12 min. Available from:

   Agency for Instructional Technology
   Box A
   Bloomington, IN 47402
   800-457-4509

C. Periodicals relating to manufacturing processes:

1. *American Machinist*
   McGraw-Hill
   13955 Manchester
   Manchester, MO 63011

2. *Fischertechnik Newsletter*
   Fisher America, Inc.
   2113 London Circle
   Modesto, CA 95356

## SUGGESTED ACTIVITIES

3. *Furniture Design and Manufacturing*
   Delta Communications, Inc.
   400 N. Michigan Ave.
   Chicago, IL 60611

4. *Modern Machine Shop*
   Gardner Publications
   6600 Clough Pike
   Cincinnati, OH 45244

D. Activity Supplies:

1. Plastic casting supplies may be obtained from:

   Industrial Arts Supply Co.
   5764 W. 36th St.
   Minneapolis, MN 55416-2594
   612-920-7393

2. Fisher/Lego Technic modeling kits may be obtained from:

   Transtech Systems
   Div. of Creative Learning Systems, Inc.
   9889 Hibert St., Suite E
   San Diego, CA 92131
   619-566-2880

3. CNC (CAD/CAM) equipment and supplies may be obtained from:

   Paxton/Patterson
   5719 W. 65th St.
   Chicago, IL 60638
   800-323-8484

# MANUFACTURING PROCESSES
# UNIT D-4

## TEACHER SUPPLEMENT #1—USING AIT VIDEO D-4

### Introduction and Program Summary (12:15)

This program shows how technology processes raw materials into useful products. Often the same material can be used for very different products, depending on the way it is processed. Wood can be furniture or a violin; iron may be part of a jet fighter or the engine block of a car; salt from a salt mine may end up on the dinner table or on icy sidewalks.

The program introduces six manufacturing processes. Separating involves removing one thing from another, as when meat is cut. Cutting can be done with water jets or computer-driven lasers. Forming changes the size or shape of something. In casting or molding the material in liquid form is poured into a form; as it hardens it takes the shape of that form, as melted chocolate is formed into bars and candies. Conditioning involves treating the material with heat, cold, or chemicals to strengthen its properties. Assembling brings parts together, as spokes, rim, and hub are joined to form a bicycle wheel. Finishing gives protection or decoration to the product.

A video visit to a Chrysler Corporation foundry demonstrates some of these processes and shows how new technology has saved a company and made work there safer and physically easier. Henry Crews, an industrial engineer, shows how engine blocks are made, starting from scrap metal (melted at 3000 degrees Fahrenheit in a cupola) and sand (used in the molds.) The process uses the new technology of the "impact mold line." In the future, StereoLithography® may be used to create three-dimensional models. In this process, a designer uses the CAD system to design a new product. Then a computer directs a laser which can sculpt plastic in intricate detail, according to the designer's plans.

### Video Program Objectives

The video program will illustrate

- six manufacturing processes
- examples of new trends in manufacturing technology

### Before the Program

1. Tell your students this lesson introduces the six common ways materials are processed, and some recent developments in the processing of materials. Tell them that we have previously looked at different materials that are used in the manufacture of products—the inputs. Now, we are going to see how those materials are changed into products—the process.
2. Tell students what they will be doing in the lab, and how the content of the video program will set the stage for the laboratory activity.
3. Tell students to note the following in the video program: the six secondary manufacturing processes and examples of each, and new developments in processing.

## TEACHER SUPPLEMENT #1

4. Tell students to listen for the following terms. (You might write them on the chalkboard.)

processing
casting and molding
finishing
internal structure
StereoLithography®
drag mold
raw materials
conditioning
high-pressure water jet
tempering
CAD
core
forming
assembling
laser machining
foundry
cupola
cope mold

**After the Program: Questions for Discussion and Review**

1. What is processing and why is it important? (*Processing is the changing of one thing into something else or into a different form or condition. It is important because unprocessed materials do not exist in a state ready for use in manufacturing nor do they exist in a finished product state.)*

2. Read the following descriptions to the students and ask them to identify the six types of manufacturing processes described the way each was shown in the videotape: removing excess material *(**separating**—high pressure water jet, laser cutting);* changing the shape and size of materials without changing their volume *(**forming**—bending a glass tube)*; pouring liquid material into a mold and allowing it to harden *(**casting**—making chocolate candy bars);* changing the internal structure of material *(**conditioning**—tempering metal to make it tougher);* process of bringing parts or materials together and combining *(**assembling**—putting bicycle together with nuts and bolts, by welding, etc.)* process done to protect and/or improve appearance of final product *(**finishing**—applying finish to baseball bats)*

   The process at the Chrysler foundry involved examples of all six processes. Can the students name them? *(**separating**—blocks removed from sand molds; **casting**—pouring molten iron into molds; **conditioning**—dipping the core to cover with a coating; **assembling**—the core, drag, and cope molds are assembled together; **finishing**—the engine blocks are ground smooth)*

3. What examples of these types of processes have you experienced in school or at home? *(Student responses and discussion. Some common home examples might include **casting** water to make ice cubes; **separating** materials with scissors or a knife; **conditioning** food by cooking it; **forming** a paper airplane by folding or bending paper; **assembling** a model airplane, car, rocket, or toy; **finishing** a notebook by "doodling" on it or coloring a picture, or spray painting an item to protect it or improve its looks.)*

4. How did changes in the way Chrysler processed materials affect the company? *(Class discussion; it saved the company by making it more productive and competitive.)*

5. What new ways of processing materials were illustrated in the video or have you seen? *(robotics, high-pressure water jet machining, laser machining, StereoLithography®, impact mold line, other)*

## MANUFACTURING PROCESSES
## UNIT D-4

## TEACHER SUPPLEMENT #2—CROSSWORD PUZZLE

Name ______________________________ Date ____________________

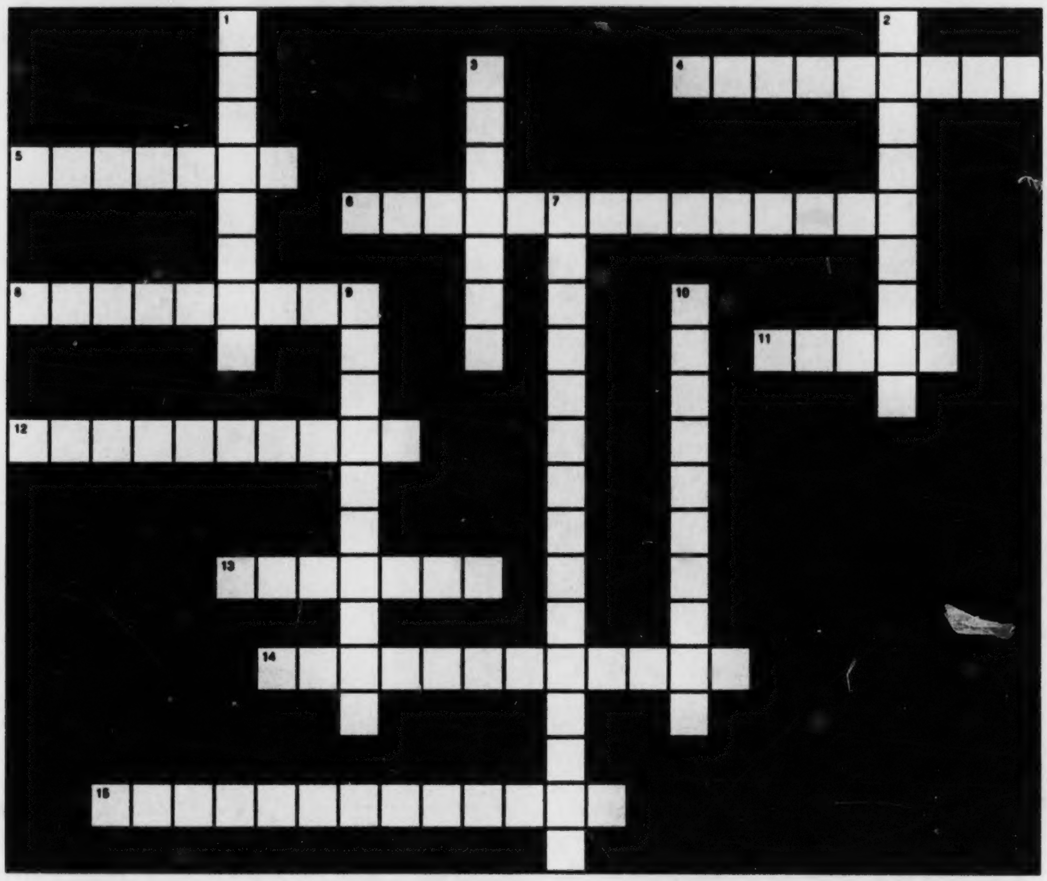
Directions: Use the clues below to solve the crossword puzzle.

ACROSS

4. Cements and glues
5. Type of conditioning that uses heat
6. Dies and rolls
8. Mechanical devices used to hold materials together
11. A point of contact between solid materials
12. Threaded and nonthreaded fasteners
13. Pouring liquid material into a mold and hardening
14. Changing the internal structure of a material
15. Common shapes, sizes, or weights of materials

DOWN

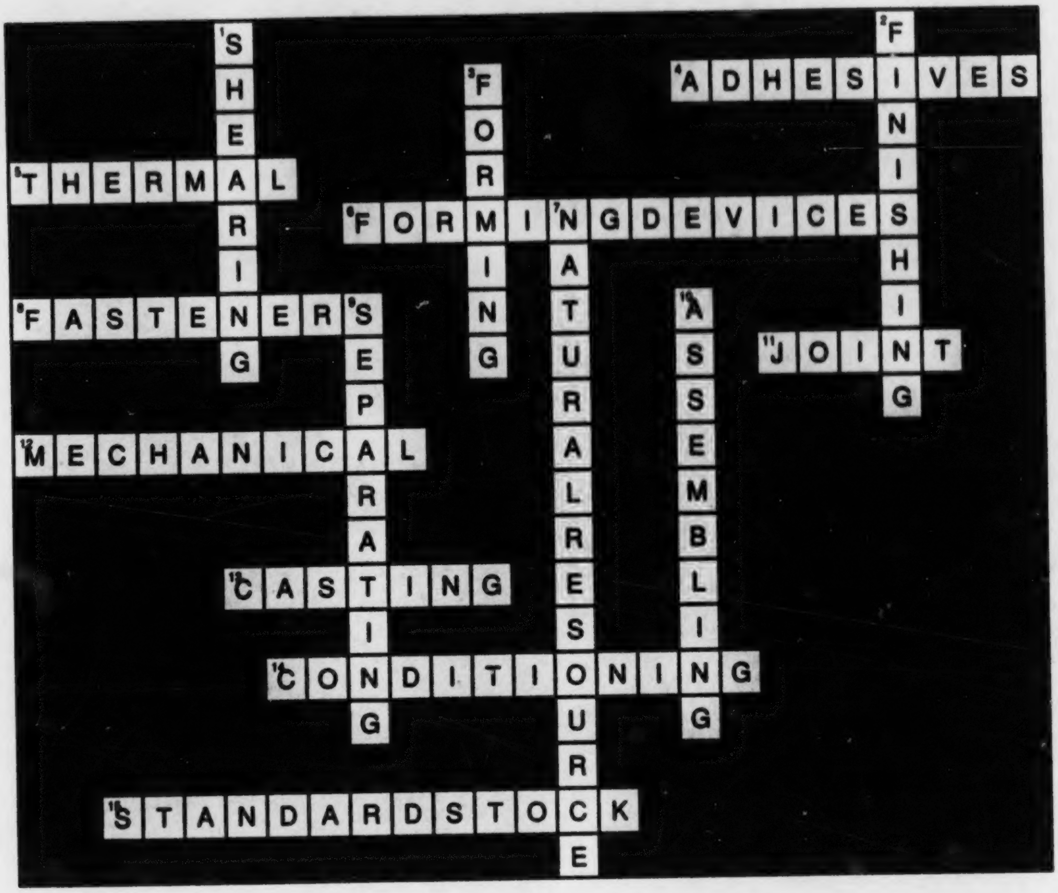
1. Using opposing edges to fracture material away
2. Any operation done to protect or decorate a product
3. Changing the size and shape of a material
7. Coal, trees, metal ore, sand, clay, etc.
9. Removing excess material
10. When parts are brought together permanently



Duplication Permitted

## TEACHER SUPPLEMENT #2

## CROSSWORD PUZZLE ANSWER KEY


1 SHEARING
2 FINISHING
3 FORMING
4 ADHESIVES
5 THERMAL
6 FORMINGDEVICES
7 NATURALRESOURCE
8 FASTENERS
9 SEPARATING
10 ASSEMBLING
11 JOINT
12 MECHANICAL
13 CASTING
14 CONDITIONING
15 STANDARDSTOCK

# MANUFACTURING PROCESSES
# UNIT D-4

## TEACHER SUPPLEMENT #3—WORD SEARCH

Name ______________________________ Date ____________________

Directions: Find the words below hidden in the puzzle. Circle the words that you find.

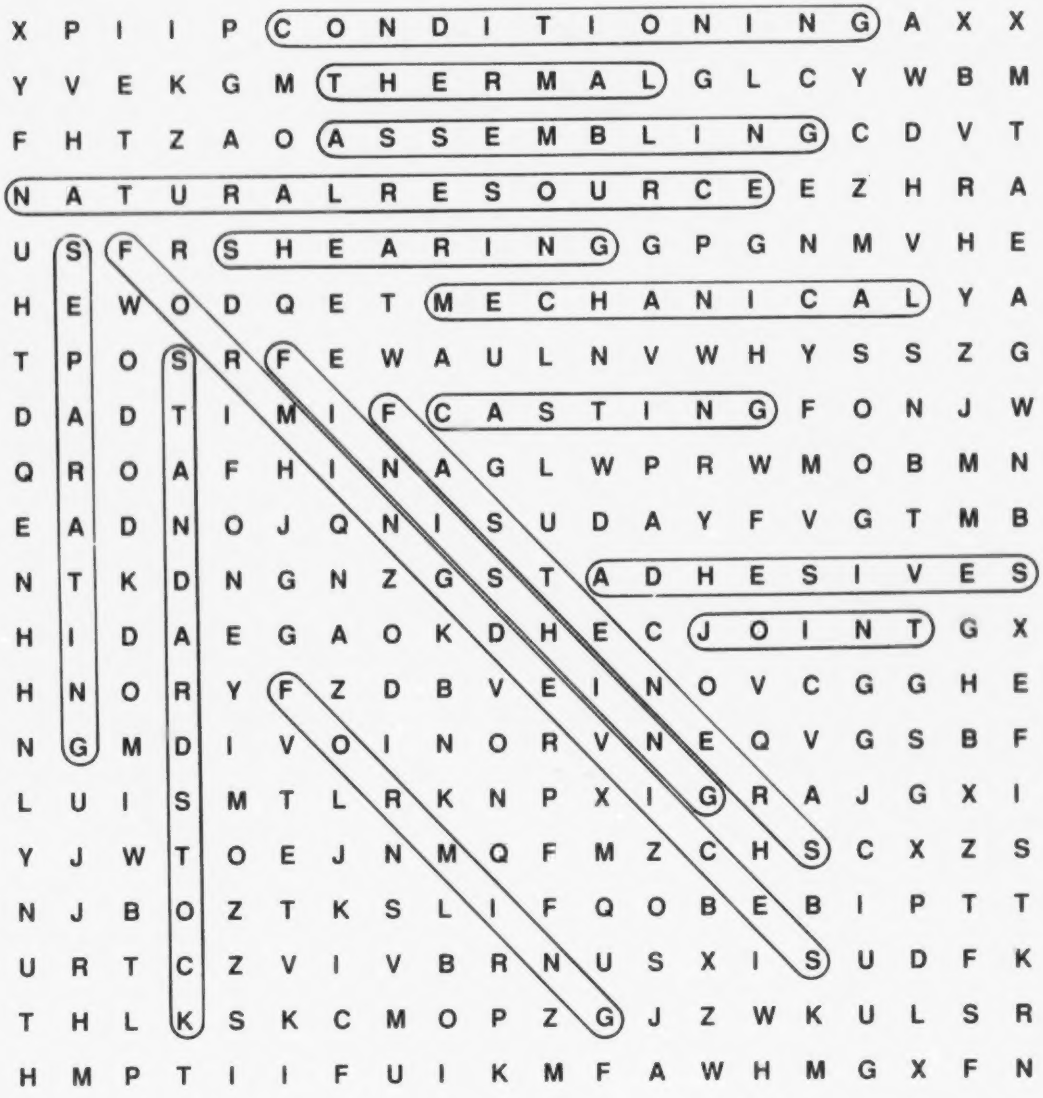
NATURAL RESOURCE
ASSEMBLING
SHEARING
FORMING DEVICES
MECHANICAL
FORMING
STANDARD STOCK
FASTENERS
CASTING
CONDITIONING
FINISHING
THERMAL
SEPARATING
ADHESIVES
JOINT

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| X | P | I | I | P | C | O | N | D | I | T | I | O | N | I | N | G | A | X | X |
| Y | V | E | K | G | M | T | H | E | R | M | A | L | G | L | C | Y | W | B | M |
| F | H | T | Z | A | O | A | S | S | E | M | B | L | I | N | G | C | D | V | T |
| N | A | T | U | R | A | L | R | E | S | O | U | R | C | E | E | Z | H | R | A |
| U | S | F | R | S | H | E | A | R | I | N | G | G | P | G | N | M | V | H | E |
| H | E | W | O | D | Q | E | T | M | E | C | H | A | N | I | C | A | L | Y | A |
| T | P | O | S | R | F | E | W | A | U | L | N | V | W | H | Y | S | S | Z | G |
| D | A | D | T | I | M | I | F | C | A | S | T | I | N | G | F | O | N | J | W |
| Q | R | O | A | F | H | I | N | A | G | L | W | P | R | W | M | O | B | M | N |
| E | A | D | N | O | J | Q | N | I | S | U | D | A | Y | F | V | G | T | M | B |
| N | T | K | D | N | G | N | Z | G | S | T | A | D | H | E | S | I | V | E | S |
| H | I | D | A | E | G | A | O | K | D | H | E | C | J | O | I | N | T | G | X |
| H | N | O | R | Y | F | Z | D | B | V | E | I | N | O | V | C | G | G | H | E |
| N | G | M | D | I | V | O | I | N | O | R | V | N | E | Q | V | G | S | B | F |
| L | U | I | S | M | T | L | R | K | N | P | X | I | G | R | A | J | G | X | I |
| Y | J | W | T | O | E | J | N | M | Q | F | M | Z | C | H | S | C | X | Z | S |
| N | J | B | O | Z | T | K | S | L | I | F | Q | O | B | E | B | I | P | T | T |
| U | R | T | C | Z | V | I | V | B | R | N | U | S | X | I | S | U | D | F | K |
| T | H | L | K | S | K | C | M | O | P | Z | G | J | Z | W | K | U | L | S | R |
| H | M | P | T | I | I | F | U | I | K | M | F | A | W | H | M | G | X | F | N |

*Duplication Permitted*

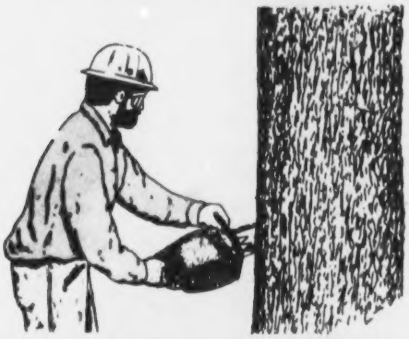
## TEACHER SUPPLEMENT #3

## WORD SEARCH ANSWER KEY



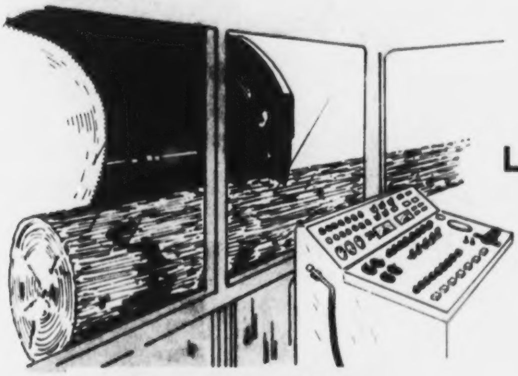
X P I I P C O N D I T I O N I N G A X X
Y V E K G M T H E R M A L G L C Y W B M
F H T Z A O A S S E M B L I N G C D V T
N A T U R A L R E S O U R C E E Z H R A
U S F R S H E A R I N G G P G N M V H E
H E W O D Q E T M E C H A N I C A L Y A
T P O S R F E W A U L N V W H Y S S Z G
D A D T I M I F C A S T I N G F O N J W
Q R O A F H I N A G L W P R W M O B M N
E A D N O J Q N I S U D A Y F V G T M B
N T K D N G N Z G S T A D H E S I V E S
H I D A E G A O K D H E C J O I N T G X
H N O R Y F Z D B V E I N O V C G G H E
N G M D I V O I N O R V N E Q V G S B F
L U I S M T L R K N P X I G R A J G X I
Y J W T O E J N M Q F M Z C H S C X Z S
N J B O Z T K S L I F Q O B E B I P T T
U R T C Z V I V B R N U S X I S U D F K
T H L K S K C M O P Z G J Z W K U L S R
H M P T I I F U I K M F A W H M G X F N

# Operations in Processing Technology



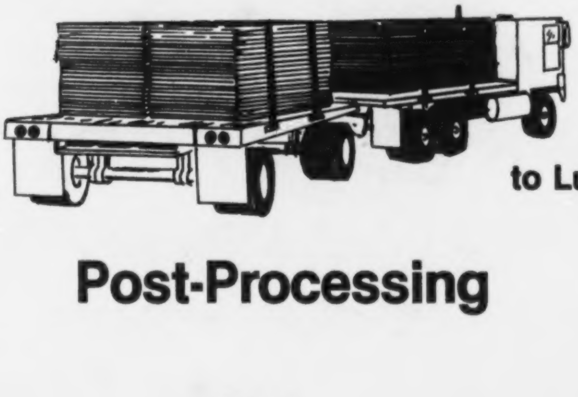
Forest

## Pre-Processing



Lumber Mill

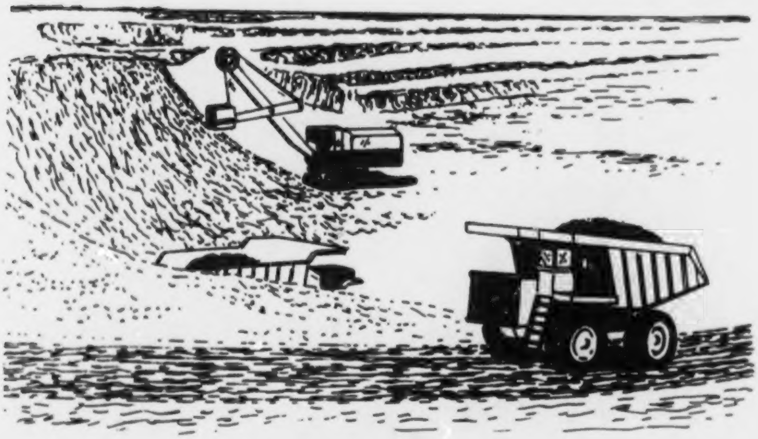
## Processing



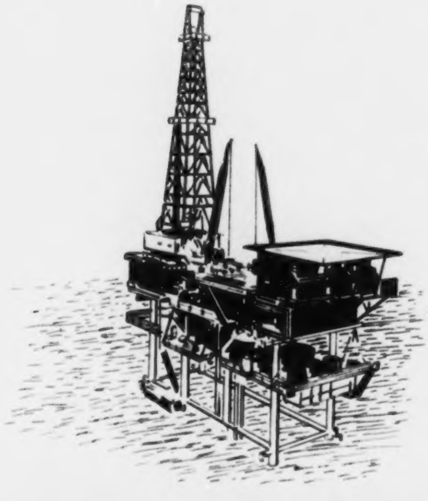
to Lumber Yard

## Post-Processing

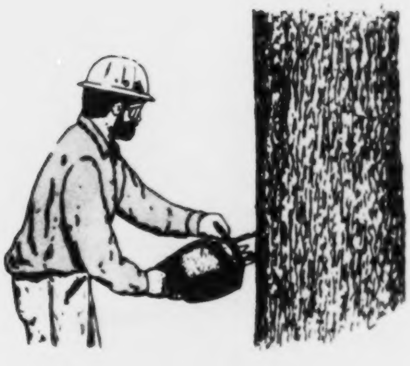
# Primary Manufacturing Processes



Mining

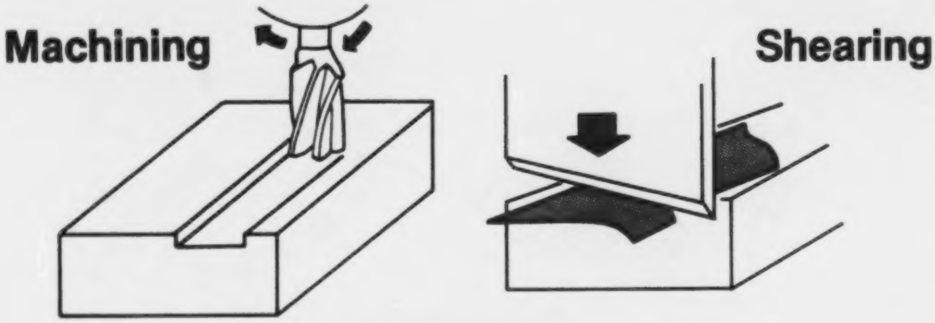


Drilling and Refining

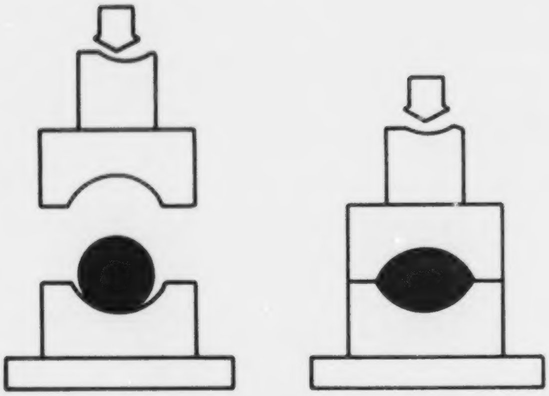


Harvesting

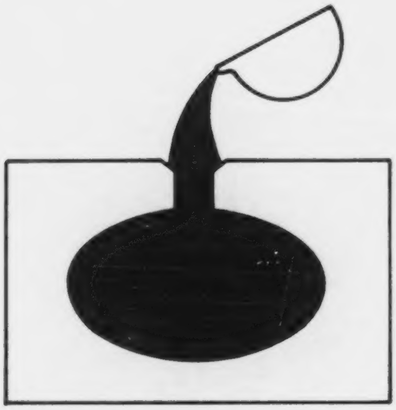
# Secondary Manufacturing Processes


Machining
Shearing

Separating

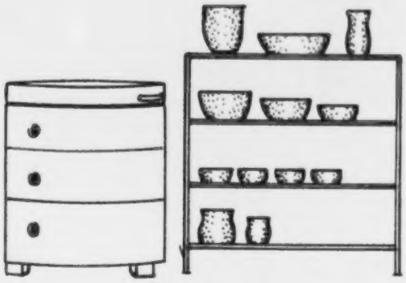


Forming

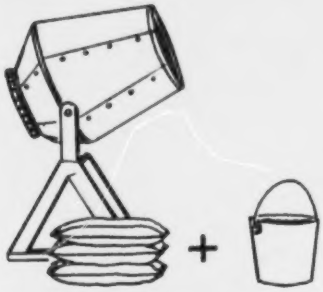


Casting

# Secondary Manufacturing Processes
## (Continued)

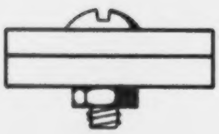


Thermal

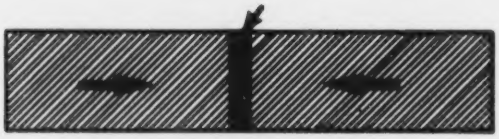


Chemical

## Conditioning

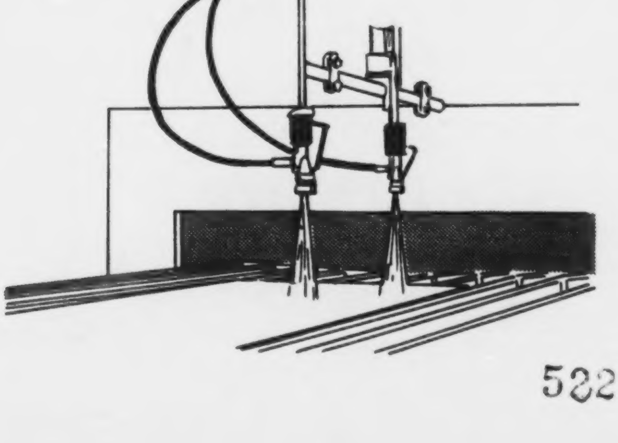


Mechanical Fasteners



Adhesives

## Assembling



## Finishing

# MANUFACTURING PROCESSES
## UNIT D-4

## INFORMATION SHEET

### I. Terms and definitions

A. Fasteners — Mechanical devices used to hold materials together

B. Industrial materials — Raw materials that have been refined and converted into standard shapes, sizes, or weights by primary manufacturing companies

C. Joint — Point of contact between solid materials or parts of a product that are being combined by bonding or mechanical fastening processes

D. Material processing — Changing the form of materials

E. Natural resource — A source of wealth or revenue supplied by nature

Examples: Coal, trees, metal ore, sand, clay, petroleum

F. Raw material — Metals, plastics, composites, or wood found in nature

G. Standard stock — Common shapes, sizes, or weights that industrial materials are produced for convenient use by consumers

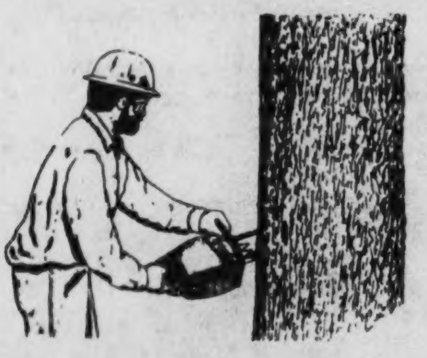
### II. Operations in processing technology

(NOTE: In early history people used materials as they were found in nature. They did not know how to change natural materials in ways that would make them more useful or easier to use. The task employed to change the form of materials to make them more useful is called processing.)

A. Pre-processing

1. All the operations that must be done to a material before it is processed

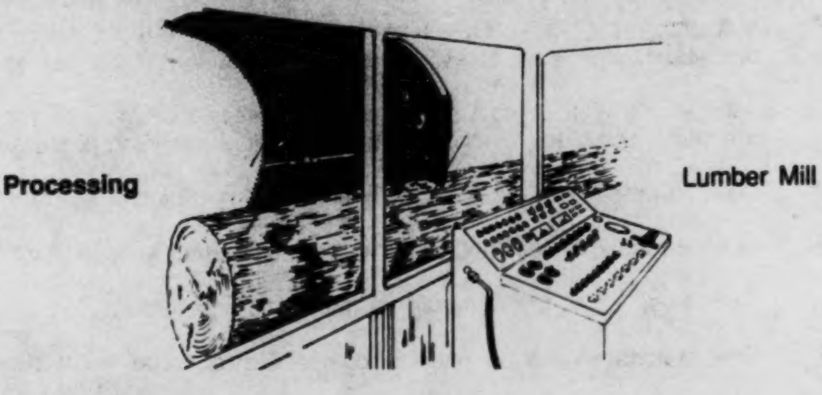
2. Includes locating, harvesting, drilling, extracting, storing, and transporting



## INFORMATION SHEET

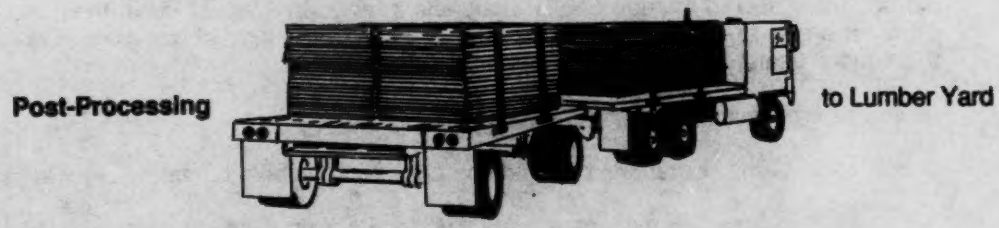
B. Processing

1. Takes place in a plant at some time such as oil refineries, lumber mills, food processing plants, and paper manufacturing plants
2. Includes both primary and secondary manufacturing processes



C. Post-processing

1. Refers to what is done to the material after it has been processed
2. Includes storing, transporting, and distributing



III. **Primary and secondary manufacturing processes**

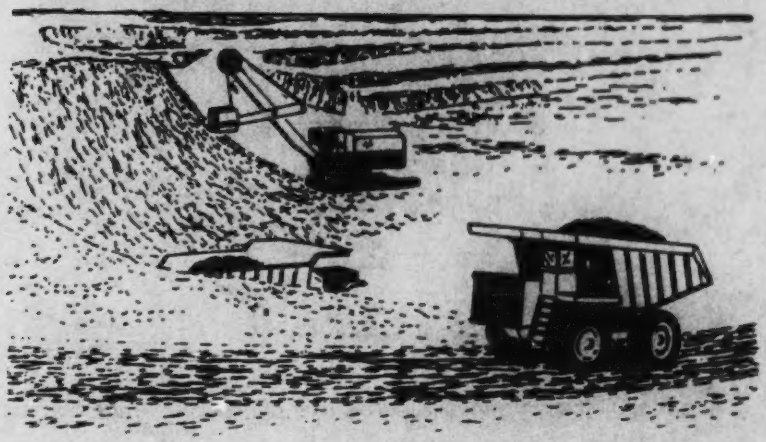
A. Primary processes — Operations by which natural resources are converted to products that manufacturing plants can use.

1. Chemical elements are combined to form various plastics.
2. Petroleum is refined to produce products such as gasoline, diesel, oil, and asphalt.
3. Trees are cut down, stripped, and cut to boards that can be used by builders.

## INFORMATION SHEET

4. Animals are slaughtered and butchered into sides or quarters to be used by the meat packing industry.

5. Metal ores are mined and then melted so the metals can be separated from the impurities.



Mining

B. Secondary processes — Operations that use the industrial materials produced by primary production processes to make finished products. There are six basic secondary processes.

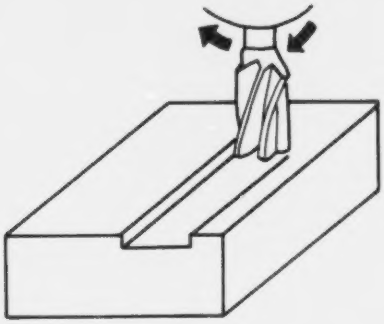
   1. Separating — Removing excess material to produce a desired size, shape, or finish
   2. Forming — Changing the size and shape of a material, but not the volume
   3. Casting — Pouring or forcing a material in liquid form into a mold and allowing it to harden before removal
   4. Conditioning — Changing the internal structure of industrial materials to give them desired properties so they can be better used
   5. Assembling — Bringing parts together so that they stay together for a definite period of time
   6. Finishing — Protecting or decorating a finished product

## INFORMATION SHEET

### IV. Major types of separating processes

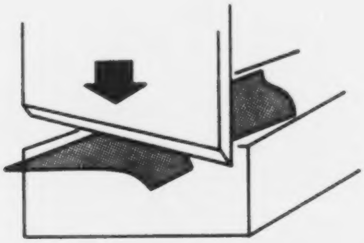
A. Machining — Changing size and shape by removing excess material by chips

Examples: Planing, drilling, routing, grinding, sawing



B. Shearing — Using opposite edges to fracture (break) the excess material away

Examples: Shearing tool or machine



(NOTE: More separating processes are performed by machining than by shearing. Can you name which tools and machines in your laboratory are used for machining and which for shearing?)

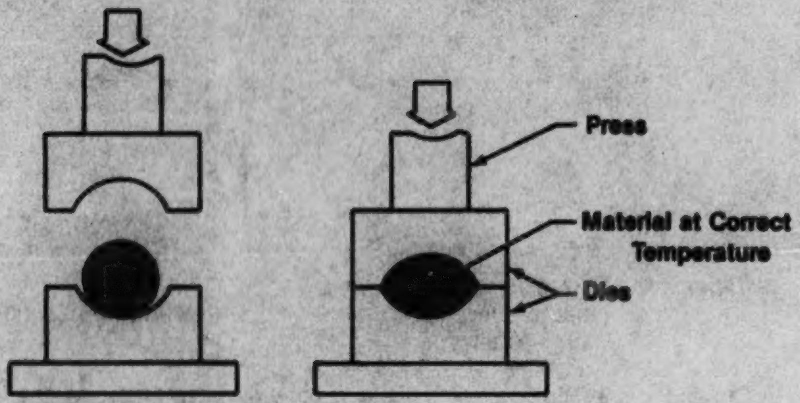
### V. Elements of the forming process

A. Forming devices — Dies and rolls that determine the final shape of the product

B. Forming temperature of material — Correct degree of heat or cold to form the material without causing internal stress

## INFORMATION SHEET

C. Method for applying force — Using hammers, presses, draw benches, or rollers to force the material against the forming devices

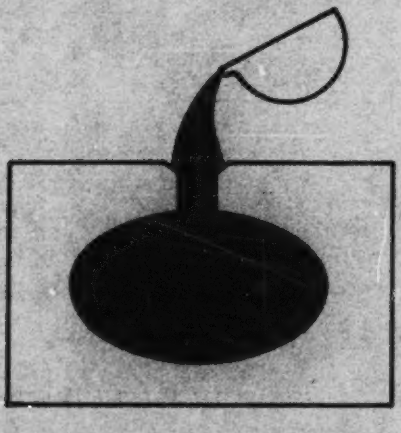


### VI. Steps in the casting process

A. A mold of the proper shape is produced. These may be one-shot molds or permanent molds for repeated use.

B. The material is prepared for casting. Material must be liquid or semiliquid.

C. Material is poured or forced under pressure into the mold.



Examples: Gravity poured — Sand mold, slip casting mold
Forced — Die casting metals, injection molding plastics

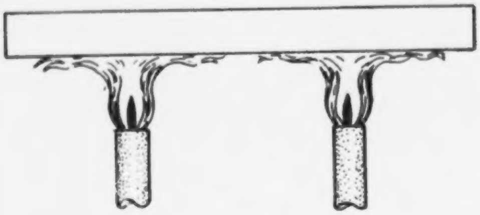
D. Material is allowed or forced to harden (solidify).

E. The finished item is removed from the mold.

## INFORMATION SHEET

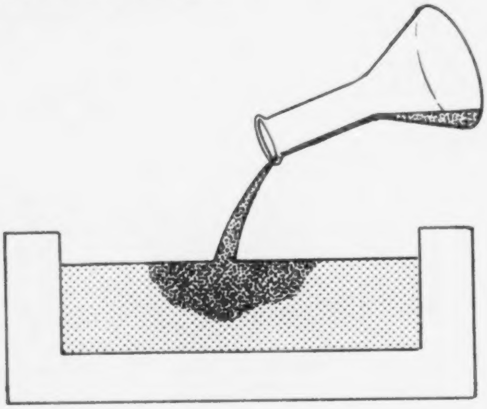
### VII. Types of conditioning processes

A. Thermal conditioning — Using heat to improve the physical or mechanical properties of a material



Examples: Drying (seasoning) wood
Heat-treating metal (hardening, tempering, annealing)
Firing ceramics

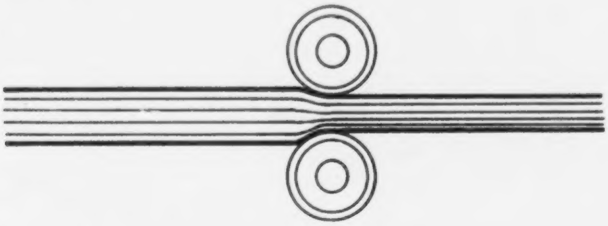
B. Chemical conditioning — Adding a chemical to improve the physical or mechanical properties of a material



Examples: Adding yeast to bread dough to make if softer, adding manganese to molten steel to make it stronger

## INFORMATION SHEET

C. Mechanical conditioning — Using pounding or squeezing action to change the internal structure and thereby improve the physical or mechanical properties of a material



Examples: Pounding steak to break the tough connecting fibers and make it more tender, compressing wood to make it take up less space and still be strong

### VIII. Assembly processes

A. Any product made up of more than one part is called an assembly. Not only are solid parts assembled, but also the mixing of liquids and gases constitute assembly.

B. A subassembly is an assembly that will be combined with other assemblies to make a product.

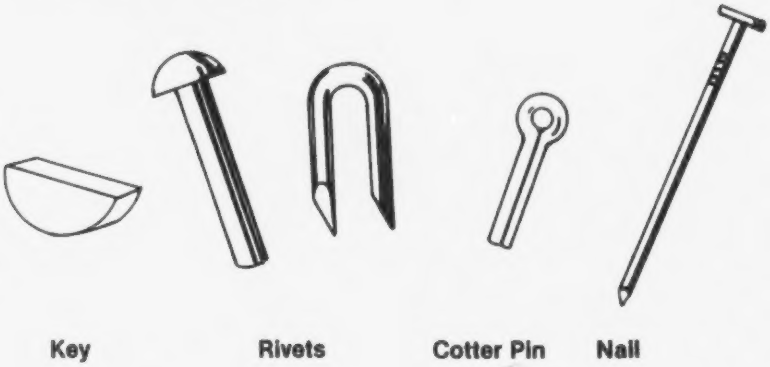
C. A final assembly is a finished product that goes to a customer.

D. Assembly operations may be fastened with several systems depending on whether they should be temporary or permanent.

1. Mechanical fasteners

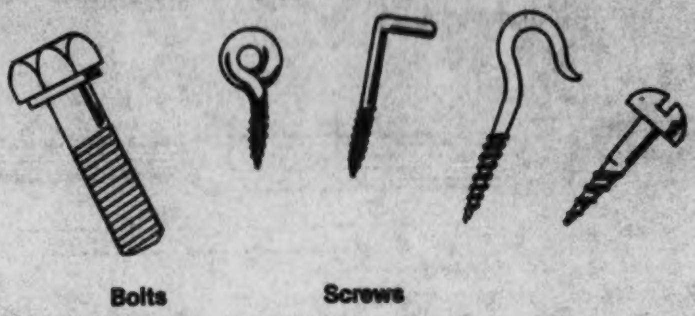
(NOTE: Mechanical fasteners are perhaps the most frequently used method of fastening materials.)

a. Nonthreaded fasteners

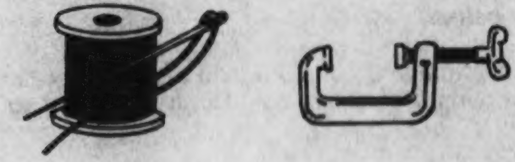


## INFORMATION SHEET

b. Threaded fasteners

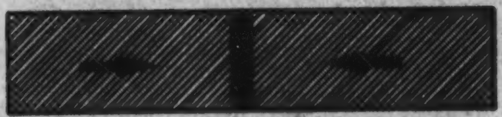


c. Miscellaneous fasteners



1) Sewing
2) Weaving
3) Pressing (clamping)
4) Pinning
5) Clipping

2. Bonding

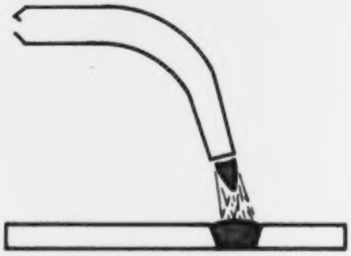


a. Cements

b. Glues

## INFORMATION SHEET

3. Welding



## IX. Major finishing operations

A. Cleaning — Using brushes or chemicals to remove deposits of grease, dust, rust, or other impurities on the surface of the product

B. Treating — Includes a number of finishing operations whose purpose is to prepare the surface for a coating process

C. Coating or plating — Includes all those processes by which a protective or decorative material is added to the surface

Examples: Plating with copper or gold, painting, plasticizing, lacquering, zinc coating

## X. General safety rules

(NOTE: Since power equipment may be used in this phase of your class, it is important that you follow each of the following rules.)

A. Obtain instructor's approval before operating any power equipment.

B. Always wear proper eye protection devices.

C. Remove jewelry and confine loose clothing and long hair.

D. Never operate a machine if over-tired or ill.

E. Operations should be thought through before being performed.

F. Make all the necessary adjustments before turning on the power.

G. Make sure all guards are in place and functioning properly.

H. Allow the machine to reach its full operating speed before starting to feed the work.

I. Only approved push sticks, push blocks, and feather-boards should be used.

J. Keep machine tables and working surfaces clear of tools, stock, and other project materials.

## INFORMATION SHEET

K. Feed the stock carefully and only as fast as the machine will accept it easily.

L. Hands should be kept a minimum distance of 4" from the cutting tool.

M. If a machine is not working properly, the instructor should be informed immediately.

N. The operator should not allow his/her attention to be distracted while using a machine.

O. Avoid "walking through" or "crowding around" areas where machines are being operated by other students.

P. Machines should never be left running while unattended.

Q. Machines should not be used for trivial operations.

R. A small brush should be used to clean machines after operations are completed.

S. When oiling or adjusting a machine, be sure the power switch is "off."

T. If an object is too heavy or awkward, get help.

U. Oily rags used to wipe down machines should be placed in a metal container.

## MANUFACTURING PROCESSES
## UNIT D-4

## ASSIGNMENT SHEET #1—IDENTIFY THE MANUFACTURING PROCESSES NEEDED TO MAKE CLASS MANUFACTURING COMPANY'S PRODUCT

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Processes listed are appropriate | ______ |
| Processes are correctly classified | ______ |
| List is complete | ______ |
| Assignment is neat and completed on time | ______ |

Directions: List below the manufacturing processes that will be needed to produce the class manufacturing company's product.

Examples: Rip a board with a table saw; a separating process
Glue boards together; an assembly process
Applying paint to a board; a finishing process

| | Activities | Types of Processes |
|---|---|---|
| 1. | ______________________ | ______________________ |
| 2. | ______________________ | ______________________ |
| 3. | ______________________ | ______________________ |
| 4. | ______________________ | ______________________ |
| 5. | ______________________ | ______________________ |
| 6. | ______________________ | ______________________ |
| 7. | ______________________ | ______________________ |
| 8. | ______________________ | ______________________ |
| 9. | ______________________ | ______________________ |
| 10. | ______________________ | ______________________ |
| 11. | ______________________ | ______________________ |

## ASSIGNMENT SHEET #1

12. ______________________ ______________________

13. ______________________ ______________________

14. ______________________ ______________________

15. ______________________ ______________________

## MANUFACTURING PROCESSES
## UNIT D-4

## ASSIGNMENT SHEET #2—IDENTIFY TOOLS AND MACHINES NEEDED TO MAKE CLASS MANUFACTURING COMPANY'S PRODUCT

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Tools and machines listed are appropriate | _____ |
| List is complete | _____ |
| Assignment is neat and completed on time | _____ |

Directions: List below the tools and machines that will be needed to produce the class manufacturing company's product.

Examples: Rip a board; table saw
Glue boards together; bar clamp
Cutting a board to length; radial arm saw

| | Activities | Tools and Machines |
|---|---|---|
| 1. | ____________________ | ____________________ |
| 2. | ____________________ | ____________________ |
| 3. | ____________________ | ____________________ |
| 4. | ____________________ | ____________________ |
| 5. | ____________________ | ____________________ |
| 6. | ____________________ | ____________________ |
| 7. | ____________________ | ____________________ |
| 8. | ____________________ | ____________________ |
| 9. | ____________________ | ____________________ |
| 10. | ____________________ | ____________________ |
| 11. | ____________________ | ____________________ |

## ASSIGNMENT SHEET #2

12. ______________________ ______________________

13. ______________________ ______________________

14. ______________________ ______________________

15. ______________________ ______________________

## MANUFACTURING PROCESSES
## UNIT D-4

### ASSIGNMENT SHEET #3—SUBSCRIBE TO A SAFETY PLEDGE

Name ________________________________ Overall Rating ______________

| EVALUATION CRITERIA | RATING |
|---|---|
| Pledge is signed | _____ |
| Completed on time | _____ |

Instructions: Each student is to complete the safety pledge listed below. After the student and the parents or guardians have read the pledge, each should sign on the appropriate blank.

### STUDENT SAFETY PLEDGE

________________________________________, who is enrolled in technology education, will as part of his/her lab experience operate machines and tools. It is understood that each student will be given proper instruction, both in the use of the equipment and in the correct safety procedures concerning it, before being allowed to operate it himself/herself.

The student must assume responsibility for safe practices, and we therefore ask that he/she subscribe to the following safety pledge:

1. I AGREE TO ABIDE BY ALL THE SAFETY RULES IN THE TECHNOLOGY LABORATORY.
2. I PLEDGE THAT I WILL TAKE PROPER CARE OF ANY TOOLS OR MACHINES THAT I USE, AND I AGREE TO RETURN THEM TO THEIR PROPER STORAGE LOCATIONS AT THE END OF THEIR USE.
3. I WILL REPORT ANY ACCIDENT TO THE TEACHER IMMEDIATELY.

DATE ______________ STUDENT SIGNATURE ________________________

I hereby give consent to allow my son/daughter to operate all machines and tools necessary in carrying out the requirements of the course in which he/she is enrolled.

DATE ______________ PARENT/GUARDIAN ________________________

(NOTE: Parents are encouraged to visit the school and inspect the technology laboratory at any time.)

# MANUFACTURING PROCESSES
## UNIT D-4

## TEST

Name ______________________________ Score ____________________

1. Match the terms on the right with the correct definitions.

______a. Changing the form of materials

______b. Raw materials that have been refined and converted into standard shapes, sizes, or weights by primary manufacturing companies

______c. Common shapes, sizes, or weights that industrial materials are produced for convenient use by consumers

______d. Point of contact between solid materials or parts of a product that are being combined by bonding or mechanical fastening processes

______e. Metals, plastics, composites, or wood found in nature

______f. Mechanical devices used to hold materials together

1. Fasteners
2. Industrial materials
3. Joint
4. Material processing
5. Natural resource
6. Raw material
7. Standard stock

2. Classify each operation in the following list as either "pre" (pre-processing), "post" (post-processing), and/or "pro" (processing).

______a. Transporting

______b. Distributing

______c. Reducing in size

______d. Conditioning

______e. Drilling

______f. Extracting

______g. Forming and combining

# TEST

3. Distinguish between primary and secondary manufacturing processes by placing a "P" next to primary or an "S" next to the secondary manufacturing processes.

______a. Conditioning by heat treatment

______b. Cutting trees down

______c. Refining petroleum

______d. Assembling a radio

______e. Mining metal ores

______f. Slaughtering animals

______g. Painting a container

______h. Sawing a board

______i. Casting a part

______j. Drilling holes in a part

4. Distinguish between the major types of separating processes by placing an "X" next to the description of machining.

______a. Changing size and shape by removing excess materials by chips

______b. Using opposing edges to fracture the excess material away

5. Select from the following list the correct elements of the forming process by placing an "X" in the appropriate blanks.

______a. Molds and casts

______b. Dies and rolls

______c. Correct temperature of material

______d. Hammers, presses, or rollers

______e. Drills, routers, or saws

6. Arrange in order the following steps of the casting process by placing the correct sequence numbers (1-5) in the appropriate blanks.

______a. Material is allowed or forced to harden.

______b. Material is poured or forced under pressure into the mold.

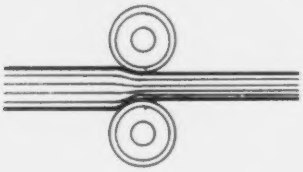
______c. A mold of the proper shape is produced.

## TEST

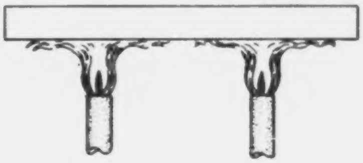
______d. The material is prepared for casting (liquid state).

______e. The finished item is removed from the mold.

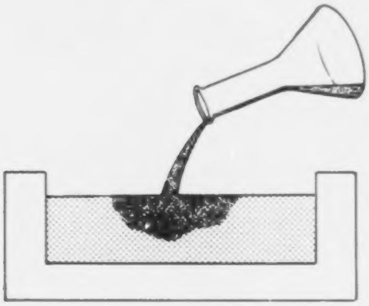
7. Distinguish between the types of conditioning processes by placing the correct names next to the following illustrations: Thermal, chemical, mechanical



a. ______________________________



b. ______________________________



c. ______________________________

8. Complete the following statements concerning assembly processes by circling the correct words.

   a. Any product made up of (one, more than one) part is called an assembly.

   b. A (primary assembly, subassembly) is an assembly that will be combined with other assemblies to make a product.

   c. A final assembly is a finished product that goes to the (design and testing department, customers).

   d. Assembly operations include mechanical fasteners, welding, and (adhesives, clamping).

## TEST

9. Distinguish between the major finishing operations by placing the following letters next to the correct descriptions:

- CL — Cleaning
- T — Treating
- CO — Coating (or plating)

______a. Includes all those processes by which a protective or decorative material is added to the surface.

______b. Using brushes or chemicals to remove deposits of grease, dust, rust, or other impurities on the surface of the product.

______c. Includes a number of finishing operations whose purpose is to prepare the surface for a coating process.

10. Select true statements concerning general safety rules by placing an "X" next to the true statements.

______a. Always wear proper eye protection devices.

______b. Make all adjustments on machines after turning on the power.

______c. Start feeding the work into the machine as soon as you turn on the power.

______d. Inform the instructor immediately of any improperly-working machine.

______e. Hands should be kept a minimum distance of 4" from the cutting tool.

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

11. Identify the manufacturing processes needed to make class manufacturing company's product. (Assignment Sheet #1)

12. Identify tools and machines needed to make class manufacturing company's product. (Assignment Sheet #2)

13. Subscribe to a safety pledge. (Assignment Sheet #3)

## MANUFACTURING PROCESSES
## UNIT D-4

## ANSWERS TO TEST

1. a. 4 d. 3
   b. 2 e. 6
   c. 7 f. 1

2. a. Pre or post e. Pre
   b. Post f. Pre
   c. Pro g. Pro
   d. Pro

3. a. S f. P
   b. P g. S
   c. P h. S
   d. S i. S
   e. P j. S

4. a

5. b, c, d

6. a. 4
   b. 3
   c. 1
   d. 2
   e. 5

7. a. Mechanical
   b. Thermal
   c. Chemical

8. a. More than one
   b. Subassembly
   c. Customers
   d. Adhesives

9. a. CO
   b. CL
   c. T

## ANSWERS TO TEST

10. a, d, e

11.-13. Evaluated to the satisfaction of the instructor

# MANUFACTURING PLANNING AND PRODUCTION
## UNIT D-5

## UNIT OBJECTIVE

After completion of this unit, the student should be able to describe the activities involved in planning, production, and marketing. Competencies will be demonstrated by completing the assignment sheets and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to manufacturing planning and production with the correct definitions.
2. Select the key principles of mass production.
3. Match the steps in production with the correct descriptions.
4. Distinguish between the responsibilities of production planning and control.
5. Select the responsibilities of industrial engineering.
6. Name the considerations in plant layout.
7. Select the characteristics of a flow process chart.
8. Identify flow chart symbols.
9. Name the responsibilities of quality control.
10. Match the key activities of marketing with the correct descriptions.
11. Prepare a flow process chart for the class manufacturing company's product. (Assignment Sheet #1)
12. Participate in production of the class manufacturing company's product. (Assignment Sheet #2)
13. Market the class manufacturing company's product. (Assignment Sheet #3)
14. Evaluate the class manufacturing company's product. (Assignment Sheet #4)
15. Evaluate the class manufacturing company by division. (Assignment Sheet #5)

## MANUFACTURING PLANNING AND PRODUCTION
## UNIT D-5

### SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher edition only and are designed to be used with the following objectives:

TM 1 — Steps in Production — Objective 3

TM 2 — Flow Chart Symbols — Objectives 7 and 8

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. Use Teacher Supplement #1 to present AIT video D-5. This video was developed by the Agency for Instructional Technology (AIT) and a consortium of states to accompany this publication. Contact your state supervisor of technology education for copies, or contact AIT directly for more information:

   Agency for Instructional Technology (AIT)
   Box A, Bloomington, IN 47402
   800-457-4509 or 812-339-2203

2. Use Teacher Supplements #2 and #3 to help students understand this unit's terminology. Make copies (fronts only) for your students. The answers are on the backs of the supplements.

3. Show and discuss examples of simple flow charts which will help in the planning of manufacturing operations. They should include the major activities from securing stock to distributing the product.

4. Have the class management team prepare a plan that provides a list of objectives to be accomplished during each day of production. Help this team prepare a detailed flow chart.

## SUGGESTED ACTIVITIES

5. Conduct the production activity and have periodic five to ten minute evaluations to facilitate smooth operations. Have the class make adjustments when necessary.

6. Conduct an overall evaluation of the production activity which should result in a list of processes that went well and processes that could be improved upon.

7. Discuss the evaluation forms that will be used by the supervisors to evaluate their subordinates. Discuss what makes a good employee and a good boss. What happens when the boss's and the employee's expectations are not met?

8. Role play a management-labor negotiation.

9. Discuss the importance of a "good attitude" by all concerned.

10. Consider evaluations in determining the students' grades.

11. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Give test.

I. Evaluate test.

J. Reteach if necessary.

## REFERENCES USED IN DEVELOPING THIS UNIT

A. *Industrial Education: Materials and Processes, C.B.I.E. Project*. Topeka: Kansas State Department of Education, 1972.

B. *Manufacturing*. Stillwater, OK: Mid-America Vocational Curriculum Consortium, Inc., 1977.

C. *Secondary Exploration of Technology*. Topeka: Kansas State College of Pittsburg, The State Department of Education, 1974.

D. Wright, R. Thomas and Richard M Henak. *Exploring Production*. South Holland, IL: Goodheart-Willcox Co., 1985.

E. Iley, John. *Exploring Manufacturing Technology*. Stillwater, OK: Mid-America Vocational Curriculum Consortium, Inc., 1989.

F. Wright, R. Thomas and Richard M. Henak. *Exploring Production*. South Holland, IL: Goodheart-Wilcox Co., 1985.

G. Komacek, Stanley, Ann E. Lawson, and Andrew C. Horton. *Manufacturing Technology*. Albany, NY: Delmar Publishers, Inc., 1990.

## SUGGESTED ACTIVITIES

H. Wright, R. Thomas. *Manufacturing: Material Processing, Management, Careers.* South Holland, IL: The Goodheart-Willcox Company, Inc., 1984.

I. Jambro, Donald J. *Introduction to Manufacturing.* Albany, NY: Delmar Publishers, Inc., 1982.

J. *Missouri Introduction to Materials and Processing Technology Guide.* Columbia, MO: IML (Instructional Materials Laboratory), University of MO - Columbia 65202, 1989.

## SUGGESTED SUPPLEMENTAL RESOURCES

A. Films

1. *Automation—What is it?* (13 min.)

   National Association of Manufacturers
   277 Park Avenue
   New York, NY 10017

2. *Fundamentals of Quality Control* (16 min.)

   Maynard Research Council, Inc.
   718 Wallace Avenue
   Pittsburgh, PA 15221

3. *Industrial Research — Key to Jobs and Progress* (13 min.)

   National Association of Manufacturers
   2 East 48th Street
   New York, NY 10017

4. *Quality Control* (10 min.)

   University of Illinois
   Visual Aids Service
   Champaign, IL 61822

5. *Quality in Quantity* (13 min.)

   National Association of Manufacturers
   277 Park Avenue
   New York, NY 10017

## SUGGESTED ACTIVITIES

B. Videos

1. The following videotapes are available from:

   Bergwall Productions, Inc.
   P.O. Box 238
   Garden City, NY 11530-0238
   800-645-3565

   a. *Manufacturing Systems Explained: Controls and Outputs*
   b. *Manufacturing Systems Technology: Feedbacks and Outputs*

2. The following videos may be ordered from:

   Modern Talking Picture Service
   5000 Park Street North
   St. Petersburg, FL 33709-9989
   813-541-5763

   a. *Product Research...Assuring the Future*. 10 min.

   b. *Design for Quality*, 15 min.

   c. *IE's on the Job*, 13 min.

   (NOTE: Modern Talking Picture Service also has videos on environmental impacts that relate to manufacturing.)

3. *Manufacturing Process Planning*, 14 min. Available from:

   Agency for Instructional Technology
   Box A
   Bloomington, IN 47402
   800-457-4509

C. Computer software:

The following public domain software is available for IBM computers and compatibles from:

Public Brand Software
P.O. Box 51315
Indianapolis, IN 46251
800-426-3475

1. *Flowcharting* (BG14.2) — An excellent flowcharting program for manufacturing activities

2. *Express Graph* (BG3.1)

# MANUFACTURING PLANNING AND PRODUCTION
## UNIT D-5

## TEACHER SUPPLEMENT #1 — USING AIT VIDEO D-5

### Introduction and Program Summary (14:11)

This program is about planning in manufacturing—planning for quality control, planning for productivity, and planning for new products.

The program opens with a humorous scene from a business office with the soundtrack running double time to emphasize that planning for speed and efficiency is necessary to stay ahead of the competition. A visit to a B. F. Goodrich plant making braking systems demonstrates the role of planning for quality control. Travis Deal, senior quality inspector, describes the statistical process control (SPC) system and how it works to ensure the quality of the product. At Melroe Manufacturing, makers of Bobcat vehicles, planning for productivity has enabled the company to produce more vehicles, more cheaply, in less time. The plant has found it more efficient to buy cheaper, unoiled steel, and then treat it themselves; to use high-technology automatic-guided vehicles (AGVs) to carry chassis around; to take advantage of CAD-CAM design processes; and to institute "just-in-time" manufacturing to avoid warehousing and inventory costs.

At the headquarters of Sunrise Publications, viewers witness a committee deciding new card lines and designs and visit briefly with an artist. Product manager Kim Turner describes the planning process, which includes market research and sales reports. A visit to the print shop in August shows Christmas cards coming off the press; planning must be done months in advance. Other committees must plan for inventory, sales, and facilities. The program concludes by reviewing several technologies of the future, and asking students, "What changes would you like to plan?"

### Video Program Objective

The video program will illustrate the importance of planning the manufacture of a product.

### Before the Program

1. Tell your students that this video discusses planning in manufacturing technology.

2. Ask students if they ever make plans before they do something (making a trip, going to a concert, making or doing a project). Ask them why they need to make plans. How do they make plans? What can happen if planning is not done or not done well? Tell them that product manufacturers know the value of planning and this video provides examples of how three companies utilize planning in the manufacture of their products.

3. Tell students what they will be doing in the lab, and how the content of the video program will set the stage for the laboratory activity.

4. Tell students to note the following in the video program: what kinds of planning a company must do: the concept of productivity; the description and value of statistical process control (SPC); how technology has changed planning and production in manufacturing; "just-in-time" planning; and careers associated with planning.

## TEACHER SUPPLEMENT #1

5. Tell students to listen for the following terms. (You might write them on the chalkboard.)

designers
product quality
machinist
trade
productivity
warehouse
engineers
quality control
machine operator
production
CAD-CAM
inventory
research and development
statistical process control
quality control inspector
automatic guided vehicle
just-in-time manufacturing
product manager

### After the Program: Questions for Discuss and Review

1. Planning plays a vital role in manufacturing. What are things a company must plan? *(**planning new products**—what products to make; **planning for productivity**—how to make them efficiently; **planning for quality control**—making sure the product is free of all possible defects or problems)*

2. What is an example of a planning program that is being used to ensure quality? *(statistical process control—SPC)*

3. What is SPC and how does it work? *(SPC is a system used to understand and predict quality level and improve productivity. Each machine operator collects data from his machine and records it on a chart; a computer translates data into a graphic; if information indicates a problem, workers form a group to plan solutions.)*

4. How has technology changed the way employers work with their machines? *(Formerly, people in the trade ran machines more as an art, sometimes by "the seat of their pants"—now it is treated more scientifically.)*

5. What is increased productivity? *(producing more products in less time at lower cost)*

6. Describe ways computers were used in this video for planning and production in manufacturing. *(CAD-DAM; SPC; figuring how many parts can be cut from any piece of steel)*

7. What is "just-in-time" manufacturing? *(Raw materials arrive just in time for use on the line. Large warehouses and large inventories become unnecessary.)*

8. Describe some of the planning procedures done at the three companies featured in the video? *(**B.F. Goodrich**—used SPC for quality control; **Melroe**—planned for increased productivity by use of cheaper, untreated steel, automated material handling, CAD-CAM, and "just-in-time" manufacturing; **Sunrise**—planning for new products (new card lines); planning production schedules so cards can be produced and shipped to the marketplace in time for holiday season shopping; planning for inventory, sales, and facilities)*

9. As manufacturing becomes more complex in the future and new technology brings about new materials, processes, and products, what changes would you like to plan? *(student input and discussion)*

## MANUFACTURING PLANNING AND PRODUCTION
## UNIT D-5

### TEACHER SUPPLEMENT #2 — CROSSWORD PUZZLE

Name ______________________________ Date ______________

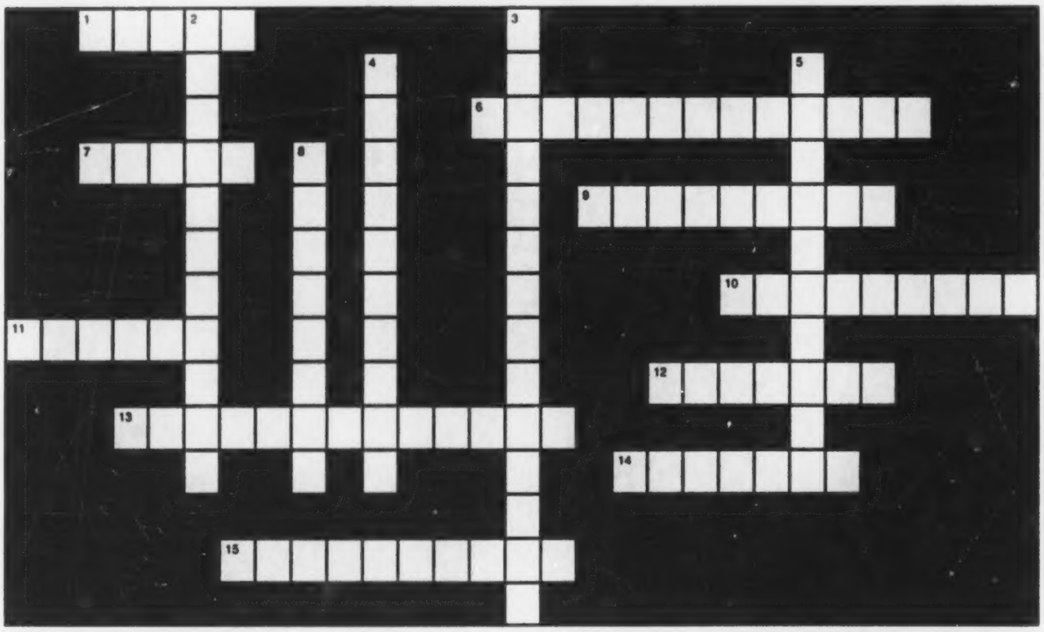
Directions: Use the clues below to solve the crossword puzzle.

ACROSS

1. Stopping, awaiting next activity, etc.
6. Costs that are dependent on external conditions
7. Provides a method for selling products
9. Creates newspaper advertisements
10. A diagram that indicates the sequence of operation
11. Devices used to check the accuracy of parts
12. Identifies path that the product follows
13. Producing parts, subassemblies, and final assemblies
14. Placing an object in a protected location
15. Engineers the facilities

DOWN

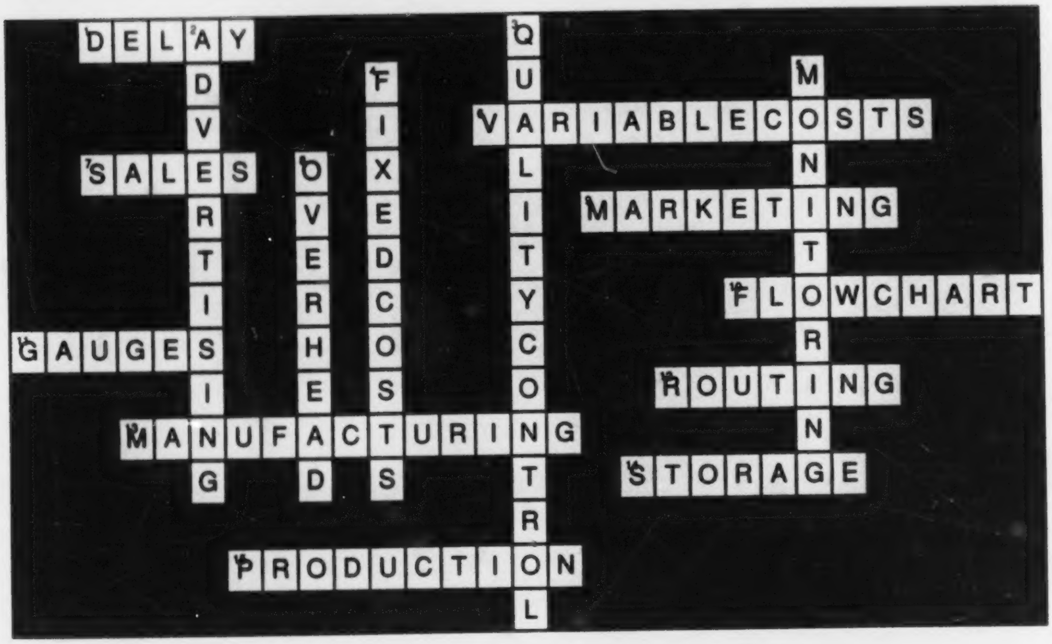
2. Communicate information about products to consumer
3. Ensuring that the product meets standards
4. Costs that are unlikely to change
5. Checks the product quality and quantity
8. Expenses such as rent, insurance, etc.



*Duplication Permitted*

## TEACHER SUPPLEMENT #2

## CROSSWORD PUZZLE ANSWER KEY


DELAY
ADVERTISING
QUALITYCONTROL
FIXEDCOSTS
MONITORING
VARIABLECOSTS
SALES
OVERHEADS
MARKETING
FLOWCHART
GAUGES
ROUTING
MANUFACTURING
STORAGE
PRODUCTION

## MANUFACTURING PLANNING AND PRODUCTION
## UNIT D-5

### TEACHER SUPPLEMENT #3 — WORD SCRAMBLE

Name ________________________________________ Date ____________

Directions: Unscramble the letters to form words we are studying. Write the words in the spaces on the right.

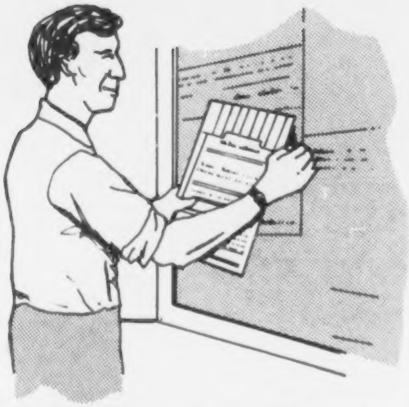
1. IROMOTNGIN _ _ _ _ _ _ _ _ _ _
2. SAGUEG _ _ _ _ _ _
3. NURIGOT _ _ _ _ _ _ _
4. QTLOYRCNLIOATU _ _ _ _ _ _ _   _ _ _ _ _ _ _
5. EVRDEOHA _ _ _ _ _ _ _ _
6. SAELS _ _ _ _ _
7. DSVIATEGIRN _ _ _ _ _ _ _ _ _ _ _
8. IKEGTMRAN _ _ _ _ _ _ _ _ _
9. FMINAUUGNATCR _ _ _ _ _ _ _ _ _ _ _ _ _
10. ADELY _ _ _ _ _
11. DPNOIRTCOU _ _ _ _ _ _ _ _ _ _
12. LETSABRSAVOCI _ _ _ _ _ _ _ _   _ _ _ _ _
13. XSCFOSDTEI _ _ _ _ _   _ _ _ _ _
14. RGAETOS _ _ _ _ _ _ _
15. WCTHFOLAR _ _ _ _   _ _ _ _ _

## TEACHER SUPPLEMENT #3

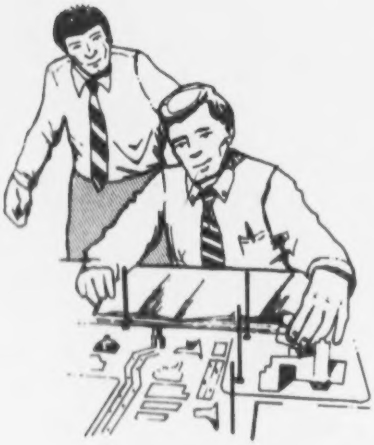
## WORD SCRAMBLE ANSWER KEY

| | | |
|---|---|---|
| 1. | IROMOTNGIN | MONITORING |
| 2. | SAGUEG | GAUGES |
| 3. | NURIGOT | ROUTING |
| 4. | QTLOYRCNLIOATU | QUALITY CONTROL |
| 5. | EVRDEOHA | OVERHEAD |
| 6. | SAELS | SALES |
| 7. | DSVIATEGIRN | ADVERTISING |
| 8. | IKEGTMRAN | MARKETING |
| 9. | FMINAUUGNATCR | MANUFACTURING |
| 10. | ADELY | DELAY |
| 11. | DPNOIRTCOU | PRODUCTION |
| 12. | LETSABRSAVOCI | VARIABLE COSTS |
| 13. | XSCFOSDTEI | FIXED COSTS |
| 14. | RGAETOS | STORAGE |
| 15. | WCTHFOLAR | FLOW CHART |

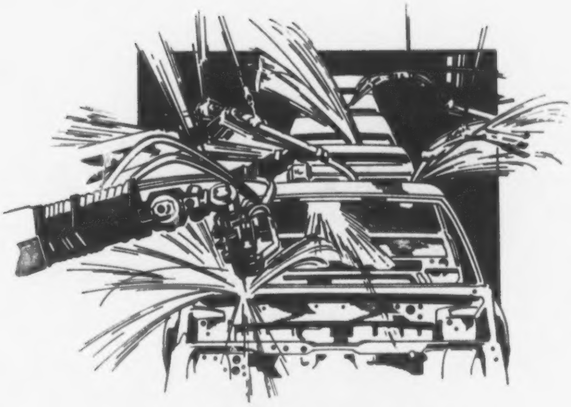
# Steps in Production



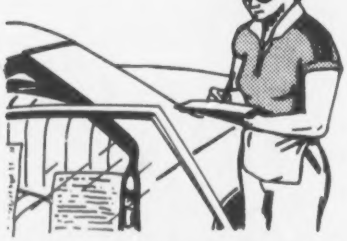
A. Production Planning and Control



B. Industrial Engineering

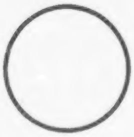


C. Manufacturing



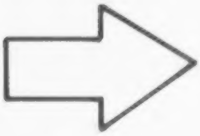
D. Quality Control

# Flow Chart Symbols



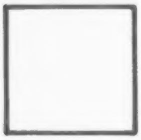
**Operation**

(CASTING, FORMING, SEPARATING, ASSEMBLING, CONDITIONING, FINISHING)



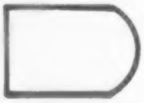
**Transportation**

(MOVING, CONVEYING, ETC.)



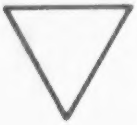
**Inspection**

(EXAMINING AND CHECKING QUALITY)



**Delay**

(STOPPING, AWAITING NEXT ACTIVITY)



**Storage**

(PLACING AN OBJECT IN A PROTECTED LOCATION)

# MANUFACTURING PLANNING AND PRODUCTION
## UNIT D-5

## INFORMATION SHEET

I. **Terms and definitions**

A. Fixed costs — Costs that are unlikely to change such as rent and utilities

B. Fixture — Device for supporting work during machining

C. Flow chart — Diagram that indicates the order of operations as materials move through a series of processes to become a finished product

D. Gauges — Devices used for measuring and for checking the accuracy of parts

E. Interchangeability of parts — Parts produced in quantity, any one of which will fit the assembly for which it is to be a component

F. Jig — Device used to maintain the correct position between the workpiece and the tool during machining or assembly

G. Marketing — Activities which determine the type, quality, and quantity of products to be produced, and contributes to the sale of products to a consumer

(NOTE: Marketing is the bringing together of those who manufacture products with those who buy them. It is a two-way exchange.)

H. Market survey — A list of questions used with the public to determine the need for or the probable acceptance of a product

I. Overhead — Expenses such as rent, insurance, and utilities that are not chargeable to a particular part of the work or product

J. Productivity — The rate of producing manufactured products

K. Quality — All of the features and characteristics of a product or service that bear on its ability to satisfy given needs

L. Variable costs — Costs that are dependent on external conditions such as labor and materials

II. **Key principles of mass production**

A. Parts are duplicated accurately to make interchangeability possible.

B. Each worker does a specific job.

C. Tools, equipment, and workers are placed in the order (sequence) of operations needed to be done.

## INFORMATION SHEET

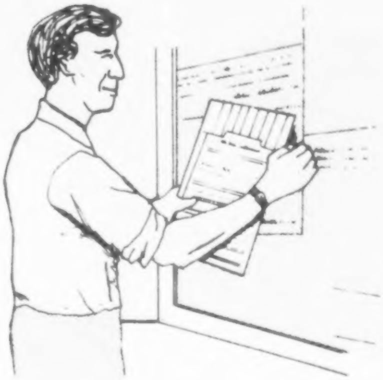
D. Wasted time and motion are eliminated.

  1. Parts and assembly are brought to and from workers by conveyors or other material-handling devices.

  2. Distances that parts and subassemblies travel are kept as short as possible.

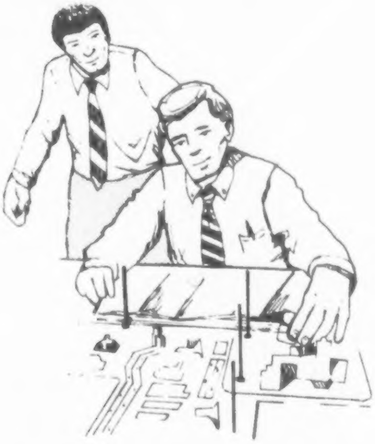
III. **Steps in production**

A. Production planning and control — Scheduling for labor, materials, and machines



**Production Planning and Control**

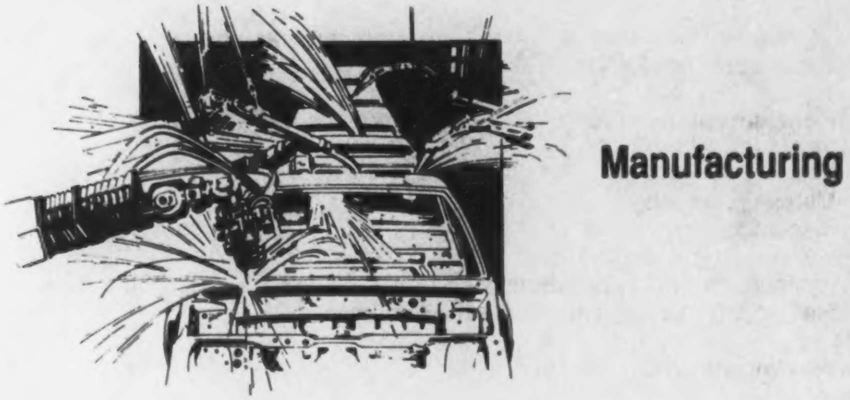
B. Industrial engineering — Plant layout, tooling, jigs and fixtures, templates, layout handling, and time and method studies



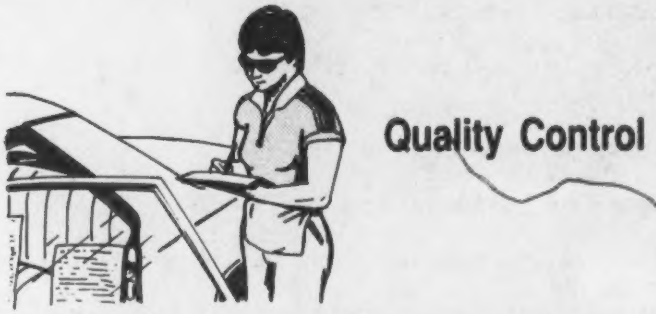
**Industrial Engineering**

## INFORMATION SHEET

C. Manufacturing — Producing parts, subassemblies, and final assemblies



D. Quality control — Ensuring that the product meets standards



IV. **Responsibilities of production planning and control**

A. Routing — Identifies the path a product follows as each operation is performed throughout the plant

B. Loading — Determines the total time it takes to complete the needed operations on a part

C. Scheduling — Determines the time and place each operation will be performed, thereby regulating the volume of production

D. Monitoring — Checks the product quality and quantity against the production plan

## INFORMATION SHEET

V. **Responsibilities of industrial engineering**

A. Selection and sequence of manufacturing operations — Uses flow process charts to show the sequence of tasks needed to manufacture a part

B. Tooling — Refers to jigs and fixtures, patterns and templates, and tools which are used in production

C. Plant layout — Planning the use of floor space in all operations of manufacturing

D. Material handling — Provides for the movement of materials within a manufacturing plant

E. Improvement of manufacturing system -- Finding a better way by analyzing the system through time and motion studies

VI. **Considerations in plant layout**

A. Location of machines

B. Movement of materials

C. Location of aisles for movement of people and material

D. Location of utility hookups (electricity, water, gas, air, etc.)

(NOTE: Safety and productivity are the underlying considerations in all of these.)

VIII. **Characteristics of a flow process chart**

A. Describes the tasks to be done

B. Lists tasks in the order they should be done

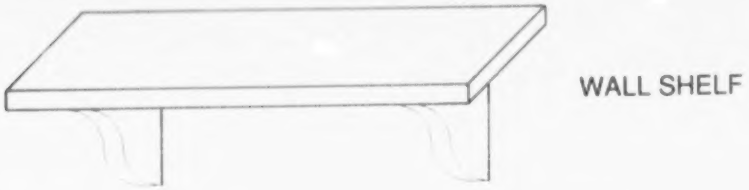
C. Categorizes the types of manufacturing activities as operation, transport, inspection, delay, or storage

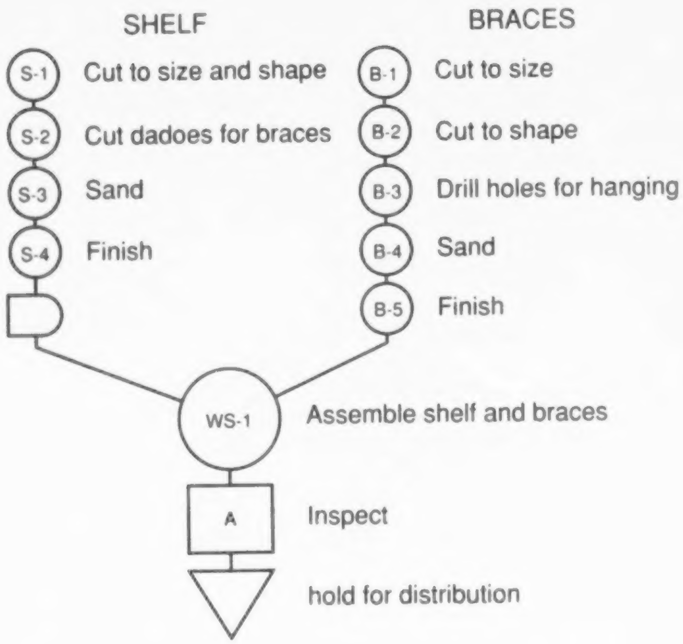
D. Identifies the machines to be used

E. Lists the tooling needed for the task

## INFORMATION SHEET

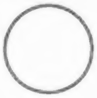
Example: Flow process chart for constructing a wall shelf



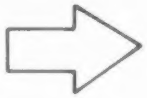

SHELF
BRACES
S-1
Cut to size and shape
S-2
Cut dadoes for braces
S-3
Sand
S-4
Finish
B-1
Cut to size
B-2
Cut to shape
B-3
Drill holes for hanging
B-4
Sand
B-5
Finish
WS-1
Assemble shelf and braces
A
Inspect
hold for distribution

### VIII. Types of flow chart symbols

A. Operation — Manufacturing processes of casting, forming, separating, assembling, conditioning, or finishing

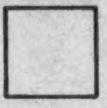


B. Transportation — Moving, conveying raw or finished materials

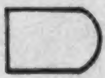


## INFORMATION SHEET

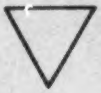
C. Inspection — Examining and checking quality



D. Delay — Stopping, awaiting next activity



E. Storage — Placing an object in a protected location



### IX. Responsibilities of quality control

A. To develop a program that provides for quality to be built into the product

B. To develop an inspection system that checks the part or product against the product specifications

### X. Activities of marketing

A. Market research — Gathers, analyzes, and interprets facts and opinions concerning the marketing of products

B. Advertising — Communicates information about company products with the public to encourage sales

## INFORMATION SHEET

C. Sales — Provides an organized method for selling the company's products

D. Distribution — Moves the product from the manufacturing organization to the consumer

# MANUFACTURING PLANNING AND PRODUCTION
## UNIT D-5

## ASSIGNMENT SHEET #1 — PREPARE A FLOW PROCESS CHART FOR THE CLASS MANUFACTURING COMPANY'S PRODUCT

Name ______________________________ Overall Rating ______________

| EVALUATION CRITERIA | RATING |
|---|---|
| All steps are listed in order | ______ |
| Correct symbols are used | ______ |
| Assignment is neat and completed on time | ______ |

Directions: Draw a flow process chart that will show all the steps and parts needed to manufacture the class manufacturing company's product. Use the correct symbols for a flow chart and make sure everything is in order of production.

## MANUFACTURING PLANNING AND PRODUCTION
## UNIT D-5

## ASSIGNMENT SHEET #2 — PARTICIPATE IN PRODUCTION OF THE CLASS MANUFACTURING COMPANY'S PRODUCT

Name ______________________________ Overall Rating ______________

| EVALUATION CRITERIA | RATING |
|---|---|
| Participated in production | ______ |
| Followed safety rules | ______ |
| Showed teamwork | ______ |
| Demonstrated good workmanship | ______ |

Directions: Use the flow process chart developed in Assignment Sheet #1 to manufacture the class manufacturing company's product. Follow the safety rules listed below.

**Safety rules for the technology education student**

1. Do not work in the lab without supervision or special permission.
2. Never operate an electrical power tool in or around water.
3. Remove or tightly secure loose clothing to the body when working in the shop.
4. Never use a power tool with a frayed or damaged cord, and report it to the instructor.
5. Before plugging in a power tool, make sure the switch is off.
6. Never operate a piece of equipment without the permission of your instructor.
7. When changing the cutting tool, always unplug the power tool.
8. Never crowd around a piece of equipment during operation.
9. Put away all tools not being used and keep the floor clear of hazards.
10. Never set the blade to project more than 1/8 inch below or above the thickness being cut.
11. Never attempt to stop a piece of equipment by jamming it or stock into the blade.
12. If anything unusual happens, turn off the power tool and report it to your instructor.
13. Do not leave a piece of equipment until it has stopped completely.

## ASSIGNMENT SHEET #2

14. Always wear approved eye protection in a technology lab.
15. Always lift hand power tools from the stock before turning it off.
16. Never leave a power tool with the power on.
17. Always use a brush to clean the workbench.
18. Always follow the flow process chart for the project, step by step.
19. Always follow correct procedure during operation of equipment.
20. Never remove any guards before operating a piece of equipment without the permission of your instructor.

    (NOTE: The evaluation of the manufacturing product is provided in Assignment Sheet #4.)

## MANUFACTURING PLANNING AND PRODUCTION
## UNIT D-5

## ASSIGNMENT SHEET #3 — MARKET THE CLASS MANUFACTURING COMPANY'S PRODUCT

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Research is complete | ______ |
| Sales and advertising planned are appropriate | ______ |
| Assignment is neat and completed on time | ______ |

Directions: Develop a marketing plan for the class manufacturing company's product. Consider both the consumer's and the manufacturer's needs. Complete the following information.

**Market Research:**

1. Information about the product
   a. Type of product — ______________________________
   b. Product description — ______________________________
   ______________________________
2. Information about the market
   a. Targeted consumer's age — ______________________________
   b. Targeted consumer's sex — ______________________________
   c. Targeted consumer's location — ______________________________
3. Information about the marketing system
   a. Selling methods — ______________________________
   ______________________________
   ______________________________

## ASSIGNMENT SHEET #3

b. Advertising campaign: Advertising can be done by newspaper, magazines, television, radio, brochures, posters, flyers, etc. The advertisement should contain features of the product (what it will do and how it looks), price of the product, where to buy the product, how to care for the product, and how to use the product. Describe your advertising below.

c. If the method of advertising selected is graphic in any way, develop a sketch in the space provided below.

## MANUFACTURING PLANNING AND PRODUCTION
## UNIT D-5

### ASSIGNMENT SHEET #4 — EVALUATE THE CLASS MANUFACTURING COMPANY'S PRODUCT

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Evaluation is accurate | _____ |
| Assignment is neat and completed on time | _____ |

Directions: Use the form below to evaluate the class manufacturing company's product. Place a check mark in the "Yes" or "No" blanks to designate whether or not the product satisfactorily meets the specifications.

| | YES | NO |
|---|---|---|
| 1. Correct length (± ⅛") | _____ | _____ |
| Comments: ______________________________ | | |
| ______________________________ | | |
| 2. Correct width (or height) (± ⅛") | _____ | _____ |
| Comments: ______________________________ | | |
| ______________________________ | | |
| 3. Correct thickness (or depth) (± ⅛") | _____ | _____ |
| Comments: ______________________________ | | |
| ______________________________ | | |
| 4. Good surface condition | _____ | _____ |
| Comments: ______________________________ | | |
| ______________________________ | | |
| 5. Proper joints | _____ | _____ |
| Comments: ______________________________ | | |
| ______________________________ | | |

## ASSIGNMENT SHEET #4

| | YES | NO |
|---|---|---|
| 6. Accurately assembled | ______ | ______ |
| Comments: ______________________________ | | |
| ______________________________ | | |
| 7. Good finish | ______ | ______ |
| Comments: ______________________________ | | |
| ______________________________ | | |

## MANUFACTURING PLANNING AND PRODUCTION
### UNIT D-5

## ASSIGNMENT SHEET #5 — EVALUATE CLASS MANUFACTURING COMPANY BY DIVISION

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Evaluation is accurate | _____ |
| Assignment is neat and completed on time | _____ |

Directions: Use the form below to evaluate the class manufacturing company by division. Place a check mark in the "Yes" or "No" blanks to designate whether or not the division has satisfactorily performed their duties.

| | YES | NO |
|---|---|---|
| 1. Checked out proper tools and materials. | _____ | _____ |
| Comments: ____________________<br>____________________ | | |
| 2. Put on safety glasses. | _____ | _____ |
| Comments: ____________________<br>____________________ | | |
| 3. Practiced safety rules throughout procedure. | _____ | _____ |
| Comments: ____________________<br>____________________ | | |
| 4. Duty: | _____ | _____ |
| Comments: ____________________<br>____________________ | | |
| 5. Duty: | _____ | _____ |
| Comments: ____________________<br>____________________ | | |

## ASSIGNMENT SHEET #5

YES NO

6. Duty: ______ ______

Comments: ________________________

________________________________

7. Duty: ______ ______

Comments: ________________________

________________________________

8. Duty: ______ ______

Comments: ________________________

________________________________

## MANUFACTURING PLANNING AND PRODUCTION
## UNIT D-5

### TEST

Name ______________________________ Score ____________________

1. Match the terms on the right with the correct definitions.

_____a. Devices used for measuring and for checking the accuracy of parts

_____b. Parts produced in quantity, any one of which will fit the assembly for which it is to be a component

_____c. Expenses such as rent, insurance, and utilities that are not chargeable to a particular part of the work or product

_____d. Costs that are unlikely to change such as rent and utilities

_____e. Device used to maintain the correct position between the workpiece and the tool during machining or assembly

_____f. Diagram that indicates the order of operations as materials move through a series of processes to become a finished product

_____g. Costs that are dependent on external conditions such as labor and materials

_____h. Device for supporting work during machining

_____i. The rate of producing manufactured products

_____j. A list of questions used with the public to determine the need for or the probable acceptance of a product

1. Fixed costs
2. Fixture
3. Flow chart
4. Gauges
5. Interchangeability of parts
6. Jig
7. Marketing
8. Market survey
9. Overhead
10. Productivity
11. Quality
12. Variable costs

## TEST

2. Select from the following list the key principles of mass production by placing an "X" next to the appropriate principles.

______a. Parts are duplicated accurately to make interchangeability possible.

______b. Each worker does several different jobs.

______c. Tools, equipment, and workers are placed in the order (sequence) of operations needed to be done.

______d. Wasted time and motion are eliminated.

3. Match the steps in production with the correct descriptions.

______a. Producing parts, subassemblies, and final assemblies

______b. Scheduling for labor, materials, and machines

______c. Ensuring that the product meets standards

______d. Plant layout, tooling, jigs and fixtures, and time and method studies

1. Production planning and control

2. Industrial engineering

3. Manufacturing

3. Quality control

4. Distinguish between the responsibilities of production planning and control by placing an "X" next to the description of routing.

______a. Determines the total time it takes to complete the needed operations on a part

______b. Checks the product quality and quantity against the production plan

______c. Identifies the path a product follows as each operation is performed throughout the plant

5. Select from the following list the responsibilities of industrial engineering by placing an "X" next to the correct responsibilities.

______a. Selection and sequence of manufacturing operations

______b. Developing quality control programs

______c. Planning the use of floor space for research and development

______d. Deciding on the tooling needed for production

## TEST

6. Name two considerations in plant layout.

   a. ____________________________________________

   b. ____________________________________________

7. Select from the following list the characteristics of a flow process chart by placing an "X" next to the correct characteristics.

   ______a. Lists the specifications that must be met

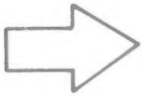
   ______b. Describes the tasks to be done

   ______c. Identifies the machines to be used

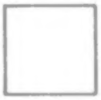
   ______d. Describes the safety procedures to be followed

   ______e. Lists tasks in the order they should be done

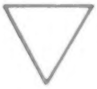
8. Identify the following flow chart symbols.



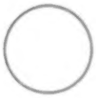
a. ______________________



b. ______________________



c. ______________________



d. ______________________

9. Name one responsibility of quality control.

   ____________________________________________

   ____________________________________________

## TEST

10. Match the activities of marketing with the correct descriptions.

_____a. Provides an organized method for selling the company's products

_____b. Moves the product from the manufacturing organization to the consumer

_____c. Gathers, analyzes, and interprets facts and opinions concerning the marketing of products

_____d. Communicates information about company products with the public to encourage sales.

1. Advertising
2. Distribution
3. Market research
4. Repairs
5. Sales

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

11. Prepare a flow process chart for the class manufacturing company's product. (Assignment Sheet #1)

12. Participate in production of the class manufacturing company's product. (Assignment Sheet #2)

13. Market the class manufacturing company's product. (Assignment Sheet #3)

14. Evaluate the class manufacturing company's product. (Assignment Sheet #4)

15. Evaluate the class manufacturing company by division. (Assignment Sheet #5)

# MANUFACTURING PLANNING AND PRODUCTION
## UNIT D-5

## ANSWERS TO THE TEST

1. a. 4 f. 3
   b. 5 g. 12
   c. 9 h. 2
   d. 1 i. 10
   e. 6 j. 8

2. a, c, d

3. a. 3
   b. 1
   c. 4
   d. 2

4. c

5. a, d

6. Any two of the following:

   a. Location of machines
   b. Movement of materials
   c. Location of aisles for movement of people and material
   d. Location of utility hookups

7. b, c, e

8. a. Transportation
   b. Inspection
   c. Storage
   d. Operation

9. Either one of the following:

   a. To develop a program that provides for quality to be built into the product
   b. To develop an inspection system that checks the part or product against the product specifications

## ANSWERS TO TEST

10. a. 5
    b. 2
    c. 3
    d. 1

11.-15. Evaluated to the satisfaction of the instructor

# INTRODUCTION TO ENERGY

## UNIT E-1

## UNIT OBJECTIVE

After completion of this unit, the student should be able to distinguish between the various sources of energy, select true statements concerning the environmental impact of energy, and list careers available. Competencies will be demonstrated by completing the assignment sheets and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to energy with the correct definitions.
2. Distinguish between the classifications of energy.
3. Identify sources of energy.
4. List past, present, and future uses of energy sources.
5. Select true statements concerning economic and environmental effects of energy.
6. Categorize parts of the energy, power, and transportation system model.
7. Select from a list the goals of energy conservation.
8. List ways to conserve energy.
9. Name careers and educational requirements for energy areas.
10. Compare energy sources. (Assignment Sheet #1)
11. Determine present personal energy needs and predict their sources if there were no fossil fuels. (Assignment Sheet #2)
12. Research and report on a career in energy, power, and transportation. (Assignment Sheet #3)

# INTRODUCTION TO ENERGY
# UNIT E-1

## SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher edition only and are designed to be used with the following objectives:

TM 1 and 2 — Sources of Energy — Objective 3
TM 3 — Past, Present, and Future Uses of Energy — Objective 4

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. Use Teacher Supplement #1 to present AIT video E-1. This video was developed by the Agency for Instructional Technology (AIT) and a consortium of states to accompany this publication. Contact your state supervisor of technology education for copies, or contact AIT directly for more information:

   Agency for Instructional Technology (AIT)
   Box A, Bloomington, IN 47402
   800-457-4509 or 812-339-2203

2. Use Teacher Supplements #2 and #3 to help students understand this unit's terminology. Make copies (fronts only) for your students. The answers are on the backs of the supplements.

3. Show films on energy. Refer to Suggested Supplemental Resources for possible films.

4. Invite local managers from the gas and electric companies and/or local government to discuss sources of energy, proportion used in community homes, alternative energy sources, and conservation.

5. Have students bring a picture from a magazine or newspaper of alternative energy sources and conservation.

6. Have class compare today's "needs" for energy with those in the past and future.

## SUGGESTED ACTIVITIES

7. Have students discuss ways they could conserve energy resources.

8. Discuss environmental problems caused by local energy resources.

9. Make a display of petrochemical products to show our reliance on petroleum. Ask students to think of alternative ways to make these products.

10. Organize a class debate on generation of electricity from coal vs. nuclear.

11. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Give test.

I. Evaluate test.

J. Reteach if necessary.

## REFERENCES USED IN DEVELOPING THIS UNIT

A. Barden, Robert and Michael Hacker. *Living with Technology*. Albany, NY: Delmar Publishers, 1988.

B. Bohn, Ralph C., et. al. *Energy, Power, and Transportation Technology*. Peoria, IL: Bennett & McKnight, 1986.

C. Bitowski, Robert, et. al. *Power/Energy*. Baton Rouge, LA: Louisiana Department of Education, Office of Vocational Education, 1984.

D. Todd, R., et. al. *Understanding and Using Technology*. Worcester, MA: Davis Publications, Inc., 1985.

## SUGGESTED SUPPLEMENTAL RESOURCES

A. Films and videotapes

1. *Energy: Critical Choices Ahead* (27 min., color). Available from:

   Texas Power and Light Public Service Dept.
   P.O. Box 226331
   Dallas, TX 75266

2. *Energy: The American Experience* (28 min., color). Available from:

   ERDA Film Library Technical Education Center
   P.O. Box 62
   Oak Ridge, TN 37830

## SUGGESTED ACTIVITIES

3. *Energy: New Sources* (20 min., color). Available from:

   University of Illinois Film Center
   1325 South Oak Street
   Champaign, IL 61820

4. *A Question of Balance* (28 min. color),
   *The Energy Experience* (24 min. color),
   *The Energy Picture* (27 min. color)

   Available from:

   Modern Talking Picture Service
   1212 Avenue of the Americas
   New York, NY 10036

5. *Overview of Energy*, 15 min. Available from:

   Agency for Instructional Technology
   Box A
   Bloomington, IN 47402
   800-457-4509

6. *Windsong*, 19 min., 1984. A historical perspective of windmills and their possible future in windpower. Available from:

   Centre Productions, Inc.
   1800 30th Street, 207
   Boulder, CO 80301
   800-824-1166

7. *Power Struggle* (2 parts). 58 min., 1986. Produced by Public Policy Productions for WNET (PBS). Narrated by Meryl Streep. Discusses energy supplies and energy efficiency. Available from:

   Bull Frog Films, Inc.
   Oley, PA 19547
   800-543-FROG

B. Books/Handbooks

*Occupational Outlook Handbook*
U.S. Department of Labor
Bureau of Labor Statistics
Washington, DC 20212

# INTRODUCTION TO ENERGY
# UNIT E-1

## TEACHER SUPPLEMENT #1—USING AIT VIDEO E-1

### Introduction and Program Summary (15:25)

This program introduces energy—its definition, sources, forms, technological advances, uses, and impact upon society and the environment. It examines the various sources of energy and describes their relative "life expectancies", benefits, and contemporary problems.

Defining energy as the ability to do work, the program opens with a brief historical survey showing that an early source of energy was human muscle power, and that the development of the highly technological society of today has depended on ample sources of energy. Sources of energy are exhaustible, renewable, or inexhaustible.

Some exhaustible energy sources derive from fossil fuels. Coal powers more than half the electrical plants in the United States. Its conversion to electricity can be described by the system model. Oil powers most transportation, and natural gas and nuclear fission are also important sources of energy. Fossil fuels pollute, however, and produce acid rain, which Professor Edwardo Rhodes, an environmental scientist, discusses.

Renewable energy sources include wood and methanol, which is produced by the bioconversion of wood, grain, or even waste into alcohol. These sources are very inefficient, however. Inexhaustible sources of energy include wind, hydroelectric, tidal, and geothermal power, and the sun, which produces solar energy through nuclear fusion. Until we develop the technology to harness the inexhaustible sources effectively, we need to work toward energy conservation and efficiency.

### Video Program Objectives

The video program will illustrate that

- there are many sources of energy, both traditional and alternative
- our use of energy sources affects society and the environment

### Before the Program

1. Tell your students this lesson introduces energy and its importance to us. Everyday we come in contact with energy—its sources, applications, limitations, and problems. Ask students how they arrived at school. Did they walk or ride in a vehicle? Have they made use of a radio, refrigerator, clock, or car? What do all these items have in common? *(all require energy.)*

2. Ask students to name sources of energy. To stimulate their responses, ask what source provides energy to operate a calculator or automobile. (If they say electricity, explain that it is a form of energy and ask for its source. If they have trouble naming the source, explain that this video program will provide answers to this question.) Tell students to look in the video program for examples of the three groups of energy sources categorized by supply availability: exhaustible sources, renewable sources, and inexhaustible sources.

## TEACHER SUPPLEMENT #1

3. Tell students what they will be doing in the lab, and how the content of the video program will set the stage for the laboratory activity.

4. Tell students to note the following in the video program: sources of energy; examples of how energy is used by people in transportation, construction, manufacturing, and communication; careers associated closely with energy; and how the use of the different energy sources affects individuals, society, and the environment.

5. Tell students to listen for the following terms and career that will be mentioned in the video program. (You might write them on the chalkboard.)

**Terms**

energy
inexhaustible sources
pollution
wind farm
solar energy
energy conservation
exhaustible sources
fossil fuels
acid rain
hydroelectric power
photovoltaic cells
renewable sources
nuclear fission
bioconversion
geothermal energy
nuclear fusion

**Career**

professor of environmental affairs

### After the Program: Questions for Discussion and Review

1. What is energy? *(The ability to do work.)*

2. What are the three supply categories in which energy sources are grouped, and what are two examples of each group shown in the video program? ***Exhaustible sources*** *are fossil fuels [coal, oil, natural gas] and uranium.* ***Renewable sources*** *are animals, plants, and waste products associated with bioconversion.* ***Inexhaustible sources*** *are wind, sun, geothermal, and water.)*

3. What are three examples of fossil fuels? What are the principal uses of each? *(**Coal** is used to fire boilers at electrical power generation plants. **Oil** powers most transportation; diesel, gasoline, and jet fuel are made from it. **Natural gas** is used primarily for heating and cooking; also used for processing materials.)*

4. What category of energy source (exhaustible, renewable, inexhaustible) currently meets 90 percent of our energy needs? *(exhaustible)* Why is it important that we use renewable or inexhaustible energy sources instead of exhaustible sources? *(exhaustible sources are running out. Also, these sources contribute to pollution and environmental problems such as acid rain.)*

5. What is "bioconversion"? *(The process of obtaining energy from plant and animal products)* Why is it inefficient? *(A relatively small amount of energy is produced.)* What is its chief benefit? *(It is renewable and can be used to produce power from trash.)*

## TEACHER SUPPLEMENT #1

6. How has our use of energy sources affected society and the environment? *(Possible responses may include pollution, better standard of living, etc.)*

7. What can be done to conserve energy in transportation? *(drive energy-efficient cars; drive at speeds that don't burn as much fuel; car pool or use mass transit vehicles)* In designing, building, and living in a home? *(insulate homes; use energy-efficient appliances)*

8. Where can we find abundant sources of clean energy? *(nuclear fusion using seawater, solar power, wind power)*

## INTRODUCTION TO ENERGY
## UNIT E-1

## TEACHER SUPPLEMENT #2—CROSSWORD PUZZLE

Name ______________________________ Date ________________

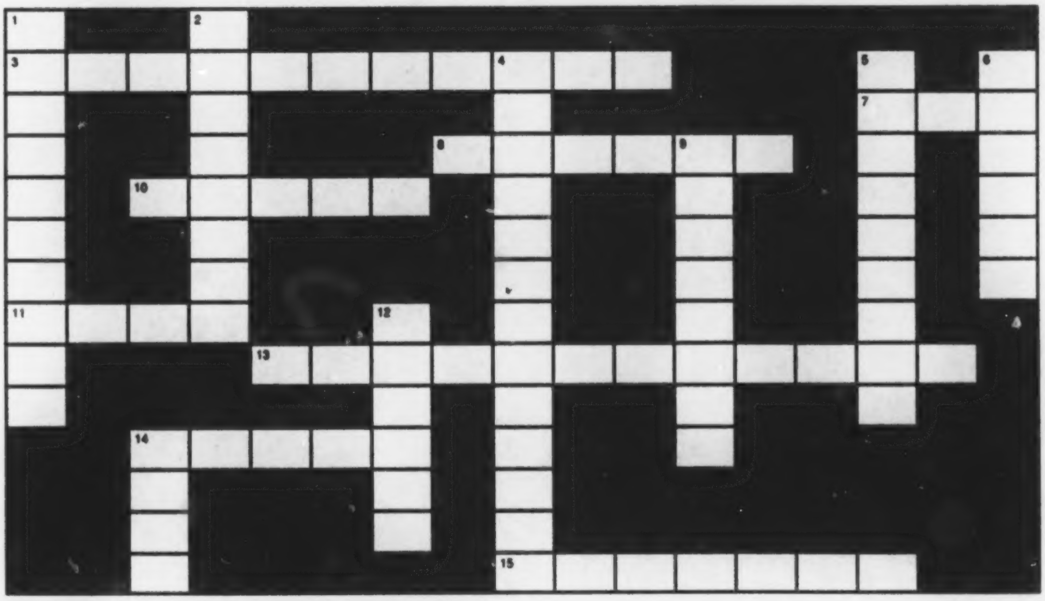
Directions: Use the clues below to solve the crossword puzzle.

ACROSS

3. Energy sources that cannot be replaced once they are used
7. Type of fossil fuel
8. Fuels derived from organisms buried millions of years ago
10. Energy from the sun
11. Use _____-transit to conserve energy in transportation
13. Planned management of resources which protects and prevents waste
14. Energy source used in hydroelectric power
15. Energy released when certain atoms are split or combined

DOWN

1. Heat from earth's interior
2. Ride in these to conserve transportation energy
4. Using plant materials and animal waste as a source of fuel
5. Reduction in the quality of the environment by the introduction of impurities
6. Biomass products
9. _______ homes to conserve energy
12. Capacity to produce work
14. Energy source used to turn windmills



*Duplication Permitted*

## TEACHER SUPPLEMENT #2

## CROSSWORD PUZZLE ANSWER KEY

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 G | | | 2 C | | | | | | | | | | | | | |
| 3 E | X | H | A | U | S | T | I | 4 B | L | E | | | | 5 P | | 6 P |
| O | | | R | | | | | I | | | | | | 7 O | I | L |
| T | | | P | | | | 8 F | O | S | S | 9 I | L | | L | | A |
| H | | 10 S | O | L | A | R | | C | | | N | | | L | | N |
| E | | | O | | | | | O | | | S | | | U | | T |
| R | | | L | | | | | N | | | U | | | T | | S |
| 11 M | A | S | S | | | 12 E | | V | | | L | | | I | | |
| A | | | | 13 C | O | N | S | E | R | V | A | T | I | O | N | |
| L | | | | | | E | | R | | | T | | | N | | |
| | | 14 W | A | T | E | R | | S | | | E | | | | | |
| | | I | | | | G | | I | | | | | | | | |
| | | N | | | | Y | | O | | | | | | | | |
| | | D | | | | | | 15 N | U | C | L | E | A | R | | |

## INTRODUCTION TO ENERGY
## UNIT E-1

### TEACHER SUPPLEMENT #3—WORD SEARCH

Name ______________________________ Date ______________

Directions: Find the words below hidden in the puzzle. Circle the words u find.

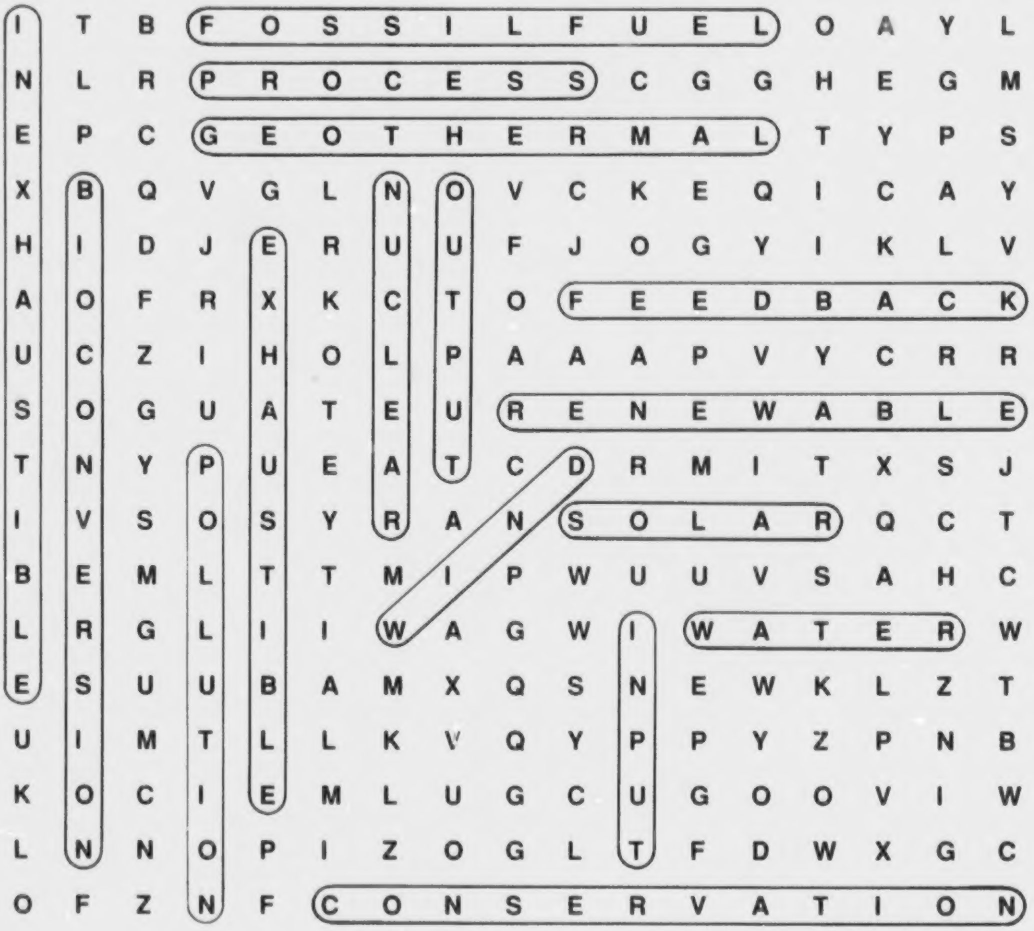
INEXHAUSTIBLE
RENEWABLE
NUCLEAR
INPUT
BIOCONVERSION
WIND
PROCESS
FOSSIL FUEL
EXHAUSTIBLE
OUTPUT
POLLUTION
SOLAR
GEOTH
FEEDB
CONSE
WATER

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | T | B | F | O | S | S | I | L | F | U | E | L | O | L |
| N | L | R | P | R | O | C | E | S | S | C | G | G | H | M |
| E | P | C | G | E | O | T | H | E | R | M | A | L | T | S |
| X | B | Q | V | G | L | N | O | V | C | K | E | Q | I | Y |
| H | I | D | J | E | R | U | U | F | J | O | G | Y | I | V |
| A | O | F | R | X | K | C | T | O | F | E | E | D | B | K |
| U | C | Z | I | H | O | L | P | A | A | A | P | V | Y | R |
| S | O | G | U | A | T | E | U | R | E | N | E | W | A | E |
| T | N | Y | P | U | E | A | T | C | D | R | M | I | T | J |
| I | V | S | O | S | Y | R | A | N | S | O | L | A | R | T |
| B | E | M | L | T | T | M | I | P | W | U | U | V | S | C |
| L | R | G | L | I | I | W | A | G | W | I | W | A | T | W |
| E | S | U | U | B | A | M | X | Q | S | N | E | W | K | T |
| U | I | M | T | L | L | K | V | Q | Y | P | P | Y | Z | B |
| K | O | C | I | E | M | L | U | G | C | U | G | O | O | W |
| L | N | N | O | P | I | Z | O | G | L | T | F | D | W | C |
| O | F | Z | N | F | C | O | N | S | E | R | V | A | T | N |

*Duplication Permitted*

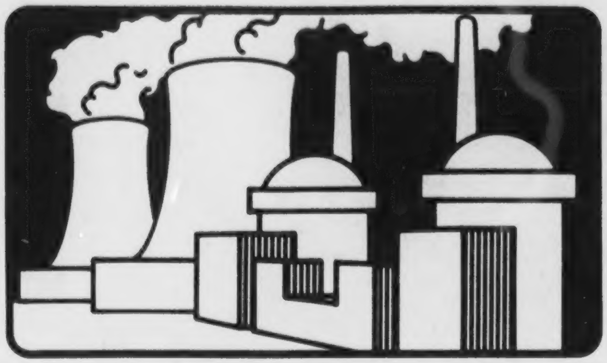
## TEACHER SUPPLEMENT #3

## WORD SEARCH ANSWER KEY

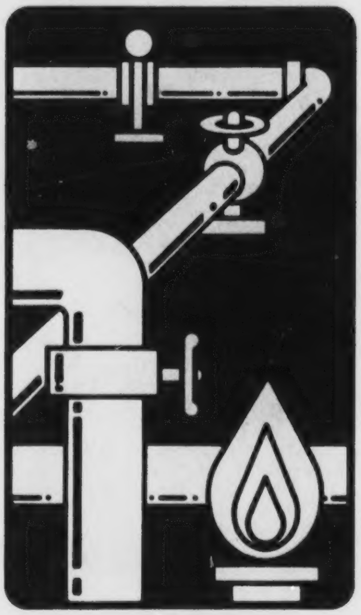


| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | T | B | F | O | S | S | I | L | F | U | E | L | O | A | Y | L |
| N | L | R | P | R | O | C | E | S | S | C | G | G | H | E | G | M |
| E | P | C | G | E | O | T | H | E | R | M | A | L | T | Y | P | S |
| X | B | Q | V | G | L | N | O | V | C | K | E | Q | I | C | A | Y |
| H | I | D | J | E | R | U | U | F | J | O | G | Y | I | K | L | V |
| A | O | F | R | X | K | C | T | O | F | E | E | D | B | A | C | K |
| U | C | Z | I | H | O | L | P | A | A | A | P | V | Y | C | R | R |
| S | O | G | U | A | T | E | U | R | E | N | E | W | A | B | L | E |
| T | N | Y | P | U | E | A | T | C | D | R | M | I | T | X | S | J |
| I | V | S | O | S | Y | R | A | N | S | O | L | A | R | Q | C | T |
| B | E | M | L | T | T | M | I | P | W | U | U | V | S | A | H | C |
| L | R | G | L | I | I | W | A | G | W | I | W | A | T | E | R | W |
| E | S | U | U | B | A | M | X | Q | S | N | E | W | K | L | Z | T |
| U | I | M | T | L | L | K | V | Q | Y | P | P | Y | Z | P | N | B |
| K | O | C | I | E | M | L | U | G | C | U | G | O | O | V | I | W |
| L | N | N | O | P | I | Z | O | G | L | T | F | D | W | X | G | C |
| O | F | Z | N | F | C | O | N | S | E | R | V | A | T | I | O | N |

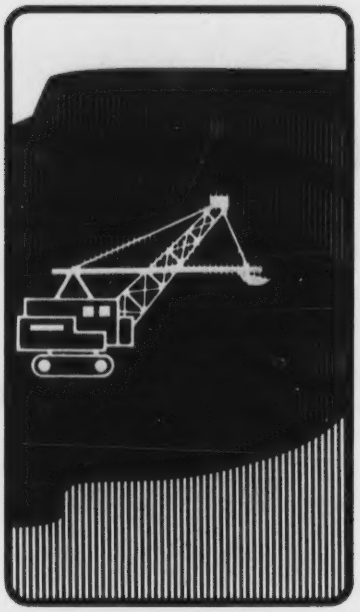
# Sources of Energy



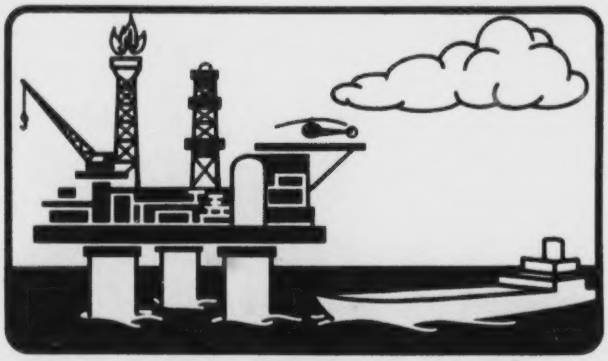
Uranium (Nuclear)



Natural Gas

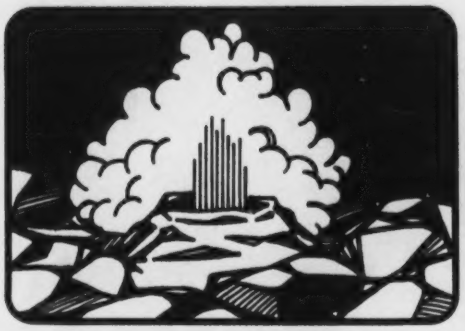


Coal

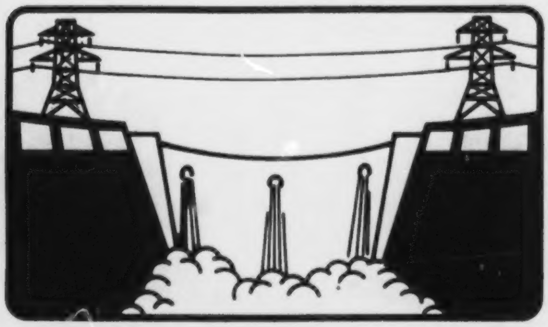


Oil

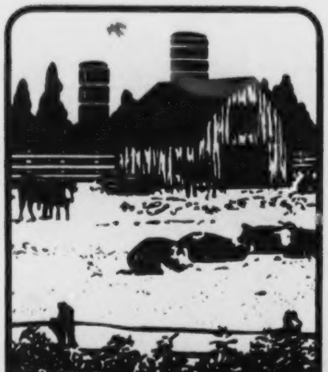
# Sources of Energy
## (Continued)



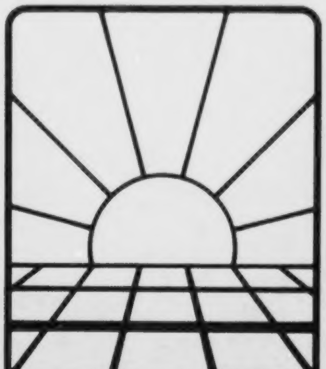
Geothermal



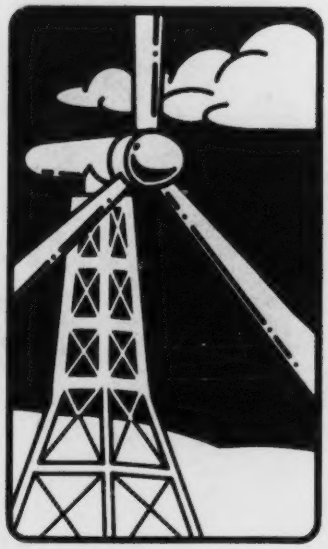
(Water)



Biomass



Solar

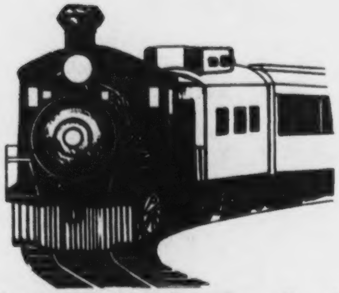


Wind

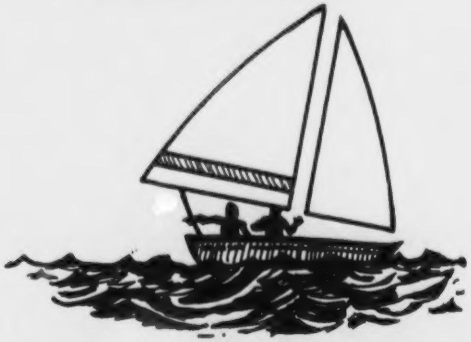
# Past, Present, and Future Uses of Energy

## (Example of Transportation Shown)

### Past

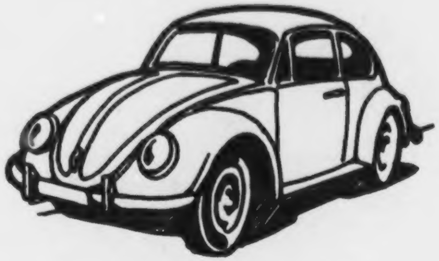


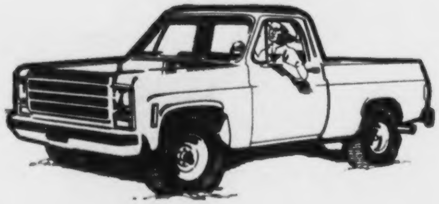
(Powered by Wood or Coal and Water [Steam])



(Powered by Water and Wind)

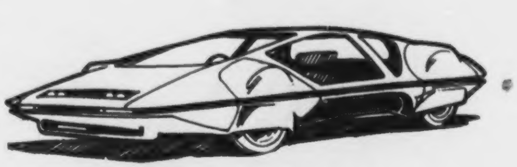
### Present



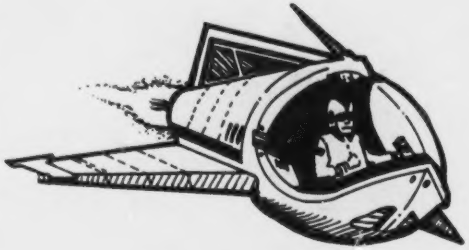


(Powered by Gasoline Engines)

### Future



(Battery-Powered)



(Solar-Powered)

TM 3

ETE-19-E

# INTRODUCTION TO ENERGY
## UNIT E-1

## INFORMATION SHEET

### I. Terms and definitions

A. Bioconversion (Biomass) — Using plant materials and animal waste as a source of fuel

B. Conservation — Planned management of resources which protects and prevents waste

C. Energy — The capacity to produce work

D. Energy reserves — Energy resources which have not been used

E. Environmental impact — Changes in the environment caused by some form of management or mismanagement

F. Fossil fuels — Hydrocarbon compounds derived from the remains of organisms (plants and animals) buried millions of years ago

G. Geothermal — Heat from the earth's interior

H. Hydroelectric power (Hydropower) — Production of electricity by falling water

I. Nuclear — Energy released when certain kinds of atoms are split (fission) or combined (fusion)

J. Pollution — A reduction in the quality of the environment by the introduction of impurities

K. Solar — Energy from the sun that produces heat and light

L. Uranium — A radioactive element which gives off energy when its atom is split

### II. Classifications of energy

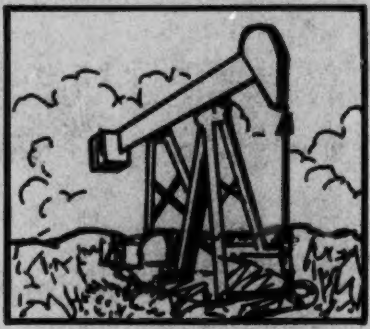
A. Inexhaustible — Energy sources that will always be available

Examples: Solar, wind, and geothermal

## INFORMATION SHEET

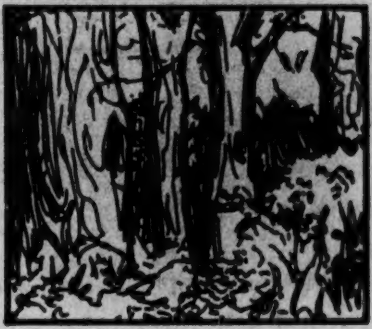
B. Exhaustible — Energy sources that cannot be replaced once they are used

Examples: Fossil fuels, nuclear energy



C. Renewable — Energy sources that can be used indefinitely if they are properly managed and maintained

Examples: Plants and animal products



### III. Sources of energy

A. Fossil fuels

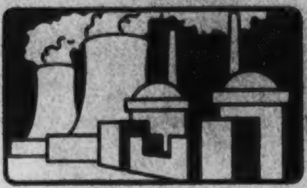
1. Coal

2. Natural gas

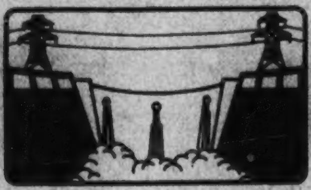
3. Oil

## INFORMATION SHEET

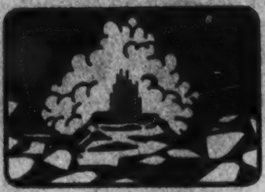
B. Uranium (nuclear)



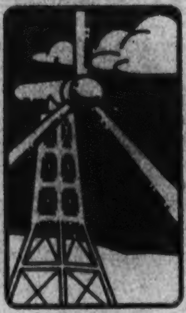
C. Water (hydroelectric power)



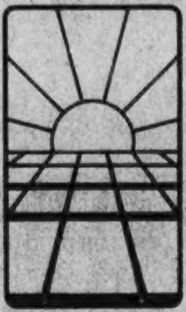
D. Geothermal



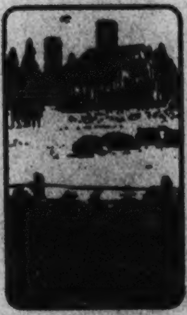
E. Wind



F. Sun (solar)



G. Bioconversion (biomass)



IV. **Past, present, and future uses of energy**

A. Wind

1. Wind was used in the past for transportation and to pump water and grind grain in windmills.
2. The primary uses of wind today are for travel and to pump water and generate electricity.
3. The greatest future use will probably be a more effective turbine for electrical production.

B. Water

1. Water was used in the past to grind grain, to saw wood, and for transportation.
2. Generating electrical power, transportation, and irrigation are today's most common uses.
3. Harnessing tidal and wave power and making them economically feasible will be this source's future.

## INFORMATION SHEET

C. Sun (solar)

1. The first example of using converted solar energy was the solar pump developed in the 1700's.
2. It is used today for heating homes and producing electricity.
3. Plans for this source include an outer space solar collector.

D. Geothermal

1. Prehistoric man first used this water and heat for heating and cooking.
2. Today it is used for heating and generating electricity.
3. Utilizing this natural source to increase heating and electrical output is planned for this source.

E. Fossil fuels

1. The earliest uses were for heating and lighting and later for transportation.
2. Today's uses of this energy source include heating, cooking, transportation, and electricity generation.
3. Decreased usage of this fuel will occur primarily due to depletion of the nonrenewable source.

F. Nuclear

1. Until a practical formula, $E = mc^2$, was invented by Einstein and proven in 1942, this source of energy was only theory.
2. Research, electricity generation, and transportation are the primary uses of this source today.
3. The future of this source lies with improved and safer reactors.

G. Bioconversion

1. Plants and animals have always been consumed by humans as food (energy) sources. Biomass products such as wood have also been used for heating and cooking.
2. Increased production allows continued use today as food sources. Grain products are being used to produce ethanol which can be used for heating or cooking or when mixed with gasoline can be used for transportation (gasohol). Some research is being done to use animal waste products to produce methane gas for heating, cooking, and transportation fuel. Also some large cities have bioconversion incinerators that produce heat from combustible trash and garbage.

## INFORMATION SHEET

3. In the future grain products may be developed that produce more ethanol. Improved incinerators may allow all cities to convert trash to energy without pollution.

**V. Environmental and economic effects of energy**

A. Wind

1. When used to produce energy, it has no harmful effect on the environment.

2. It is an unpredictable energy source and availability cannot be controlled. Therefore, it is a useful energy source in only certain areas of the world.

B. Water

1. The loss of prime farm land and wildlife habitat are some of the negative environmental effects in using hydroelectric energy.

2. Tides and the thermal action of oceans could provide additional sources of energy as soon as technology makes it economically feasible.

C. Solar

1. This source of energy is similar to wind in that it has no harmful effect on the environment.

2. The present technology does not permit economical use of this source of energy on a large scale.

D. Geothermal

1. Environmental effects include heat, waste products, and unknown contaminants.

2. Using geothermal energy is economical but it is limited to areas of high geothermal activity.

E. Fossil fuels

1. Fossil fuels present the greatest threat to the environment in the form of air and water pollutants.

2. Presently it is a relatively inexpensive form of energy but this will change when it becomes scarce.

F. Nuclear

1. Radiation fallout, spills, and disposal of waste present the greatest problems in using this form of energy.

## INFORMATION SHEET

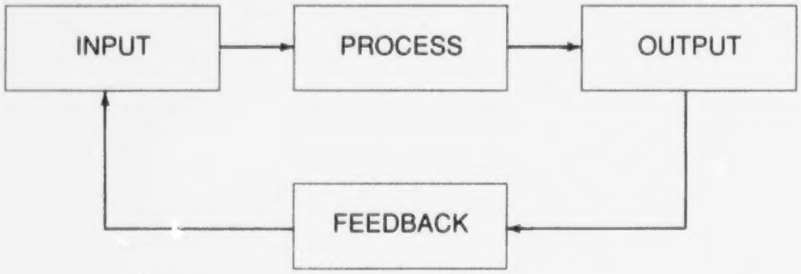
2. High cost of installation and problems with approval make this form of energy economically unattractive.

G. Bioconversion

1. When biomass products are burned, they give off pollutants. Burning wood in fireplaces and wood stoves has now been banned in many cities with high air pollution levels. New incinerators for biomass conversion use advanced systems to control air pollution. Its greatest benefit to the environment is that it reduces the volume of waste going to landfills.

2. Because biomass products are renewable, new technology can improve its conversion to become an economical source of energy.

## VI. Parts of the energy, power, and transportation system model



A. Inputs — Energy sources, people's skills and knowledge, capital, machines, and facilities

B. Processes — Converting energy to power, and transmitting, controlling, and storing that power

C. Outputs — Power is used to serve human wants and needs

D. Feedback — Users' responses, environmental impact

## VII. Goals of energy conservation

A. To save money

B. To improve the environment by reducing harmful emissions from energy use

C. To reduce the amount of energy that must be produced to meet demands

D. To reduce our reliance on foreign energy sources for political and economic reasons

## INFORMATION SHEET

### VIII. Ways to conserve energy

A. Residential — Uses 8% of total U.S. energy

1. Build energy-efficient homes.
2. Insulate and weatherstrip existing homes.
3. Turn off lights when not needed.
4. Lower thermostat settings in winter, and raise them in summer.
5. Purchase energy-efficient appliances.
6. Conserve hot water use.
7. Recycle household products and compost yard waste.

B. Transportation — Uses 19% of total U.S. energy

1. Increase vehicle fuel economy by reducing weight.
2. Reduce speed.

   (NOTE: When the national speed limit was reduced to 55 mph, 200,000 barrels of oil per day were saved.)
3. Use car pools, mass-transit, bicycles, or walk.
4. Increase fuel-efficiency of engines.
5. Improve aerodynamics of vehicle design.

C. Commercial/businesses — Uses 5% of total U.S. energy

1. Similar to residential efforts including energy-efficient buildings and conservation measures.
2. Install alternate energy devices such as solar.

D. Industrial — Uses 26% of total U.S. energy

1. Turn off equipment when not in use.
2. Improve equipment efficiency.
3. Improve manufacturing processes.
4. Reuse heat generated.
5. Recycle raw materials.

## INFORMATION SHEET

E. Electricity generation — Uses 42% of total U.S. energy

1. Conserve energy resources which are in short supply in the U.S.
2. Generate electricity by converting to U.S. energy resources which are renewable or inexhaustible.

**IX. Careers and educational requirements in energy, power, and transportation fields**

(NOTE: The careers mentioned are only a few of the hundreds possible.)

A. Generation of electricity

1. Engineer — 1
2. Plant supervisor — 2, 4, 5, 6
3. Technician — 2, 3, 4, 5, 6

B. Energy exploration and research

1. Engineer — 1
2. Geologist — 1, 2
3. Chemist — 1, 2
4. Surveyor — 1, 2
5. Cartographer (mapmaker) — 4, 5, 6

C. Transportation

1. Air traffic controller — 2, 3, 4, 5, 6
2. Truck dispatcher — 2, 3, 4, 5, 6
3. Airplane pilot — 2, 4
4. Railroad engineer — 2, 4
5. Flight engineer — 2, 4
6. Truck driver — 2, 4, 6

D. Conservation and environment protection

1. Environmental control specialist — 1, 2, 5
2. Conservation specialist — 1, 2, 5
3. Chemist — 1, 2
4. Scientist — 1, 2

1. College degree
2. On-the-job training
3. Apprenticeship
4. Specialized technical training (Armed Services, F.A.A., etc.)
5. Junior college
6. Vo-tech school

## INTRODUCTION TO ENERGY
## UNIT E-1

### ASSIGNMENT SHEET #1—COMPARE ENERGY SOURCE

Name ______________________________ Overall Rating _

| EVALUATION CRITERIA | RATING |
|---|---|
| Uses listed are appropriate | ______ |
| Impacts listed are appropriate | ______ |
| Assignment is neat and completed on time | ______ |

Directions: On the chart below, list an example of how each energy sour sed and its impact on the environment.

| Energy Source | Sample Use | Environmenta t |
|---|---|---|
| WIND | | |
| WATER | | |
| SOLAR | | |
| GEOTHERMAL | | |

## ASSIGNMENT SHEET #1

| Energy Source | Sample Use | Environmental Impact |
|---|---|---|
| FOSSIL FUELS | | |
| NUCLEAR | | |
| BIOCONVERSION | | |

## INTRODUCTION TO ENERGY
## UNIT E-1

### ASSIGNMENT SHEET #2—DETERMINE PRESENT PERSONAL ENERGY NEEDS AND PREDICT THEIR SOURCES IF THERE WERE NO FOSSIL FUELS

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Present energy sources are complete and appropriate | _____ |
| Alternate energy sources are complete and appropriate | _____ |
| Assignment is neat and completed on time | _____ |

Directions: Think about all the energy demands and uses that apply to your personal needs during the past 24 hours. List the ways you have used energy in your daily life.

| Energy Used for: | Present Energy Sources |
|---|---|
| Hygiene | |
| Food | |
| Transportation | |
| Entertainment and Communication | |

# ASSIGNMENT SHEET #2

Now predict which activities would be changed if there were no fossil fuels and what energy sources you would substitute.

| Energy Used For: | Alternate Energy Sources |
|---|---|
| Hygiene | |
| Food | |
| Transportation | |
| Entertainment and Communication | |

# INTRODUCTION TO ENERGY
## UNIT E-1

## ASSIGNMENT SHEET #3—RESEARCH AND REPORT ON A CAREER IN ENERGY, POWER, AND TRANSPORTATION

Name ________________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Research is complete | ______ |
| Report is well organized | ______ |
| Report is well presented | ______ |
| Assignment is neat and completed on time | ______ |

Directions: Examples of careers were discussed in the Information Sheet. You may be able to name other careers. Select a career you are interested in and think you could do well. Research for details. Resource material may be available in the laboratory/classroom. You may also contact the school counselor and/or librarian. The *Occupational Outlook Handbook* is a good reference source.

1. What is the exact training needed?
2. Where can you get that training?
3. What are the working conditions for that job?
4. What are the future possibilities for employment?
5. Why would you be good at that job?

Compile the results of your research and present in an oral or written report as requested by your instructor.

## INTRODUCTION TO ENERGY
## UNIT E-1

## TEST

Name ______________________________ Score ________________

1. Match the terms on the right with the correct definitions.

______a. Heat from the earth's interior

______b. A reduction in the quality of the environment by the introduction of impurities

______c. The capacity to produce work

______d. A radioactive element which gives off energy when its atom is split

______e. Energy resources which have not been used

______f. Using plant materials and animal waste as a source of fuel

______g. Planned management of resources which protects and prevents waste

______h. Energy released when certain kinds of atoms are split or combined

______i. Hydrocarbon compounds derived from the remains of organisms (plants and animals) buried millions of years ago

______j. Changes in the environment caused by some form of management or mismanagement

1. Bioconversion
2. Conservation
3. Energy
4. Energy reserves
5. Environmental impact
6. Fossil fuels
7. Geothermal
8. Hydroelectric power
9. Nuclear
10. Pollution
11. Solar
12. Uranium

2. Distinguish between the correct classifications of energy by placing inexhaustible, exhaustible, and renewable in the proper blanks.

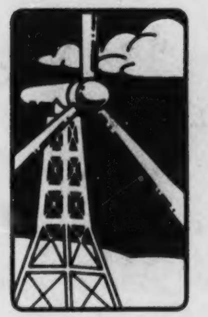
a. ____________ — Energy sources that can be used indefinitely if they are properly managed and maintained

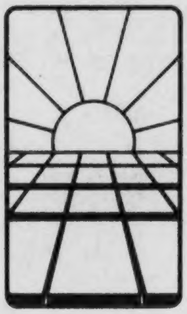
b. ____________ — Energy sources that cannot be replaced once they are used

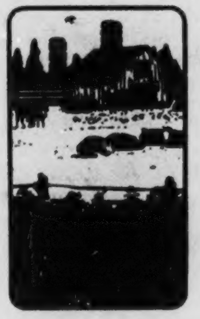
c. ____________ — Energy sources that will always be available

## TEST

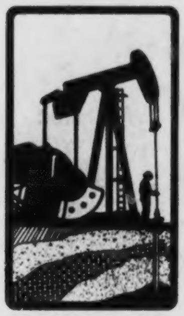
3. Identify the following sources of energy.

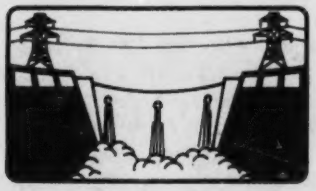






a. ________________ b. ________________ c. ________________





d. ________________ e. ________________

4. List past, present, and/or future uses of the following energy sources.

   a. How was wind used in the past?

   ____________________________________________

   ____________________________________________

   b. How is water used today as an energy source?

   ____________________________________________

   ____________________________________________

## TEST

c. How may solar energy be used today and in the future?

____________________________________________________________

____________________________________________________________

d. What does the future use of fossil fuels look like?

____________________________________________________________

____________________________________________________________

5. Select true statements concerning economic and environmental effects of energy by placing a "T" next to the true statements and an "F" next to the false statements.

______a. Biomass products such as wood are clean-burning and create very little air pollution.

______b. Fossil fuels are inexpensive forms of energy, but are a great threat to the environment.

______c. Wind has no harmful effects, but it is an unpredictable source of energy.

______d. Geothermal energy is cheap, and it can be found anywhere in the world.

______e. Radiation fallout, spills, and disposal of waste present the greatest problems in using nuclear energy.

______f. Bioconversion helps reduce the volume of waste going to landfills.

______g. The loss of prime farm land and wildlife habitat are some of the environmental effects in using hydroelectric energy.

______h. Solar energy is now used on a large scale because it is so cheap to install and use.

6. Categorize the following parts of the energy, power, and transportation system model. Label each of the following as either inputs (I), processes (P), outputs (O), or feedback (F).

______a. Environmental impact

______b. Energy sources

______c. Power is used to serve human wants and needs

______d. Converting energy to power

______e. Users' responses

______f. Transmitting power

# TEST

______g. Machines and facilities

______h. Storing power

7. Select from the following list the goals of energy conservation by placing an "X" next to the appropriate goals.

______a. To save money

______b. To produce more energy sources

______c. To use more energy

______d. To improve the environment by reducing harmful emissions

______e. To reduce our reliance on foreign energy for political and economic reasons

8. List two ways to conserve energy for each of the following energy uses.

a. Residential

1)______________________________

2)______________________________

b. Transportation

1)______________________________

2)______________________________

c. Industrial

1)______________________________

2)______________________________

d. Electricity generation

1)______________________________

2)______________________________

## TEST

9. Name a career and educational requirement for the following areas.

   a. Generation of electricity

   ______________________________________________

   ______________________________________________

   b. Energy exploration and research

   ______________________________________________

   ______________________________________________

   c. Transportation

   ______________________________________________

   ______________________________________________

   d. Conservation and environment protection

   ______________________________________________

   ______________________________________________

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

10. Compare energy sources. (Assignment Sheet #1)

11. Determine present personal energy needs and predict their sources if there were no fossil fuels. (Assignment Sheet #2)

12. Research and report on a career in energy, power, and transportation. (Assignment Sheet #3)

## INTRODUCTION TO ENERGY
## UNIT E-1

### ANSWERS TO TEST

1. a. 7
   b. 10
   c. 3
   d. 12
   e. 4
   f. 1
   g. 2
   h. 9
   i. 6
   j. 5

2. a. Renewable
   b. Exhaustible
   c. Inexhaustible

3. a. Wind
   b. Sun (solar)
   c. Bioconversion (biomass)
   d. Oil (or fossil fuel)
   e. Water (hydroelectric power)

4. Answers may vary. Evaluate to satisfaction of instructor. Discussion may include:

   a. Wind was used in the past for transportation and to pump water and grind grain in windmills

   b. Water is used today for generating electrical power, transportation, and irrigation.

   c. Solar energy is used today and probably will be used in the future for heating homes and producing electricity.

   d. Fossil fuels will be used less in the future primarily due to depletion.

5. a. F
   b. T
   c. T
   d. F
   e. T
   f. T
   g. T
   h. F

6. a. F
   b. I
   c. O
   d. P
   e. F
   f. P
   g. I
   h. P

7. a, d, e

## ANSWERS TO TEST

8. Any two for **each** of the following:

   a. Residential

      1) Build energy-efficient homes.
      2) Insulate and weatherstrip existing homes.
      3) Turn off lights when not needed.
      4) Lower thermostat settings in winter, and raise them in summer.
      5) Purchase energy-efficient appliances.
      6) Conserve hot water use.
      7) Recycle household products and compost yard waste.

   b. Transportation

      1) Increase vehicle fuel economy be reducing weight.
      2) Reduce speed.
      3) Use car pools, mass-transit, bicycles, or walk.
      4) Increase fuel-efficiency of engines.
      5) Improve aerodynamics of vehicle design.

   c. Industrial

      1) Turn off equipment when not in use.
      2) Improve equipment efficiency.
      3) Improve manufacturing processes.
      4) Reuse heat generated.
      5) Recycle raw materials.

   d. Electricity generation

      1) Conserve energy resources which are in short supply in the U.S.
      2) Generate electricity by converting to U.S. energy resources which are renewable or inexhaustible.

9. Any one from each of the following: (others may be listed)

   a. Generation of electricity

      1) Engineer — 1
      2) Plant supervisor — 2, 4, 5, 6
      3) Technician — 2, 3, 4, 5, 6

   b. Energy exploration and research

      1) Geologist — 1, 2
      2) Chemist — 1, 2
      3) Surveyor — 1, 2
      4) Cartographer (mapmaker) — 4, 5, 6
      5) Engineer — 1

   1. College degree
   2. On-the-job training
   3. Apprenticeship
   4. Specialized technical training
   5. Junior college
   6. Vo-tech school

## ANSWERS TO TEST

c. Transportation

1) Air traffic controller — 2, 3, 4, 5, 6
2) Truck dispatcher — 2, 3, 4, 5, 6
3) Airplane pilot — 2, 4
4) Railroad engineer — 2, 4
5) Flight engineer — 2, 4
6) Truck driver — 2, 4, 6

d. Conservation and the environment

1) Environmental control specialist — 1, 2, 5
2) Conservation specialist — 1, 2, 5
3) Chemist — 1, 2
4) Scientist — 1, 2

10.-12. Evaluated to the satisfaction of the instructor

# ENERGY CONVERSION AND MEASUREMENT
## UNIT E-2

## UNIT OBJECTIVE

After completion of this unit, the student should be able to distinguish between forms of energy, energy conversions, and solve problems measuring energy and power. Competencies will be demonstrated by completing the assignment sheets, lab activity sheets, and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to energy conversion and measurement with the correct definitions.
2. Distinguish between the categories of energy.
3. Match forms of energy with the correct descriptions.
4. Complete statements concerning characteristics of energy.
5. Distinguish between the types of conversions.
6. Complete statements concerning the measurement of energy and power.
7. Identify energy conversions. (Assignment Sheet #1)
8. Solve problems involving energy and power measurements. (Assignment Sheet #2)
9. Construct an electrical conversion simulator. (Lab Activity Sheet #1)
10. Construct a thermal conversion simulator. (Lab Activity Sheet #2)

## ENERGY CONVERSION AND MEASUREMENT
## UNIT E-2

### SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people lass to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of t.)

B. Make transparencies from the transparency masters included with These appear in the teacher edition only and are designed to be used w following objectives:

TM 1 — Categories of Energy — Objective 2
TM 2 — Forms of Energy — Objective 3

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as ne

G. Provide students with lab activity sheets.

H. Discuss and demonstrate the procedures outlined in the lab activity .

I. Integrate the following activities throughout the teaching of this unit

1. Use Teacher Supplement #1 to present AIT video E-2. leo was developed by the Agency for Instructional Technology (AIT) a nsortium of states to accompany this publication. Contact your stat visor of technology education for copies, or contact AIT directly for m rmation:

   Agency for Instructional Technology (AIT)
   Box A, Bloomington, IN 47402
   800-457-4509 or 812-339-2203

2. Use Teacher Supplements #2 and #3 to help students unde is unit's terminology. Make copies (fronts only) for your students. T vers are on the backs of the supplements.

3. Show films on energy. Refer to Suggested Supplemental rces for possible films.

4. Perform an experiment to measure human power as compared epower.

5. Demonstrate the production of electrical energy through the us gnetism.

6. Demonstrate the production of electricity through the use of c energy.

## SUGGESTED ACTIVITIES

(NOTE: *Principles of Technology* materials contain many experiments dealing with converting and measuring energy and power. These materials were developed by a consortium of states, CORD, and AIT. Contact your state supervisor of technology education for more information or CORD or AIT directly.

Agency for Instructional Technology (AIT)
Box A, Bloomington, IN 47402
800-457-4509 or 812-339-2203

Center for Occupational Research and Development (CORD)
601 C Lake Air Drive
Waco, TX 76710
817-772-8756

7. Alternate lab activities include constructing solar heaters/cookers or a windmill.

8. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

J. Give test.

K. Evaluate test.

L. Reteach if necessary.

## REFERENCES USED IN DEVELOPING THIS UNIT

A. Barden, Robert and Michael Hacker. *Living with Technology.* Albany, NY: Delmar Publishers, Inc., 1989.

B. Bame, E. Allen, and Paul Cummings. *Exploring Technology.* Worcester, MA: Davis Publications, Inc., 1980.

C. Bitowski, Robert, et. al. *Power/Energy.* Baton Rouge, LA: Louisiana Department of Education, Office of Vocational Education, 1984.

D. Bohn, Ralph C., et. al. *Energy, Power, and Transportation Technology.* Peoria, IL: Bennett & McKnight, 1986.

E. Groneman, Chris H. and John L. Feirer. *General Industrial Education and Technology*, 7th ed. New York: McGraw-Hill, 1986.

F. Heiner, Carl W. and Wayne R. Hendrix. *People Create Technology.* Worcester, MA.

G. Pershing, Rex. W. *Energy and Power.* Des Moines, IA: Department of Public Instruction, Career Education Division, 1980.

H. Schwaller, Anthony E. *Transportation, Energy, and Power Technology.* Albany, NY: Delmar Publishers, Inc., 1989.

## SUGGESTED ACTIVITIES

I. Smith, Howard Bud, ed. *Exploring Energy: Sources/Applications/Alternatives*. South Holland, IL. Goodheart-Willcox Company, Inc., 1985.

J. *Systems of Technology.* Austin, TX: EIMC, The University of Texas at Austin, 1986.

K. Towler, Alan L. *Power Systems.* Austin, TX: Texas Education Agency, Division of Continuing Education, 1983.

## SUGGESTED SUPPLEMENTAL RESOURCES

Films and Videotapes

A. *Your Place in the Nuclear Age* (20 min. color) #0A52. Available from:

ERDA Film Library
Technical Information Center
P.O. Box 62
Oak Ridge, TN 37838

B. *Here Comes the Sun* (15 min. color) #0499. Available from:

ERDA Film Library
Technical Information Center
P.O. Box 62
Oak Ridge, TN 37838

C. *Power* (19 min. color). Available from:

University of Illinois
Visual Aids Service
1325 South Oaks Street
Champaign, IL 61820

D. *Paths of Power* (12 min. color, video); *Sam's Most Electrifying Account* (28 min. color); *Your Future: Careers in Instrumentation and Control* (16 min. color). Available from:

Modern Talking Picture Service
5000 Park Street North
St. Petersburg, FL 33709
813-541-5763

E. *Conversion of Energy into Power*, 15 min. Available from:

Agency for Instructional Technology
Box A
Bloomington, IN 47402
800-457-4509

# ENERGY CONVERSION AND MEASUREMENT
## UNIT E-2

## TEACHER SUPPLEMENT #1—USING AIT VIDEO E-2

### Introduction and Program Summary (14:32)

This program presents different forms of energy, the conversion of one form into another, and all forms as sources of power. It introduces six ways of measuring these forms of energy. The program focuses on the use of these forms of energy today and requirements for the future.

Defining power as the rate of doing work, the program opens with scenes of a solar-powered car racing across Australia. The narrator explains that energy is useful only when it is converted into power. Examples are shown of the six forms of energy: heat, chemical, mechanical, light, electrical, and nuclear. Potential or stored energy is converted into kinetic or mechanical energy; humans store chemical energy and release it in mechanical form, while coal stores the radiant energy of the sun. A tour of a coal-fired electrical plant shows how the production of electricity can be described in terms of the systems model.

Conversion of energy involves some loss, often as thermal energy. Energy used or lost can be measured as force, work, torque, pressure, BTUs, or horsepower. The narrator returns to the example of the General Motors Sunraycer® and describes its great energy efficiency. An interview with its designer, Paul MacCready, is the occasion for presenting his earlier designs, including human-and solar-powered aircraft. The systems model describes the conversion of solar energy into mechanical power. The future will require great energy efficiency. Seawater is a possible source of power. Nuclear fission will not be fully effective as a source of power until we can solve the problem of nuclear wastes.

### Video Program Objectives

The video program will illustrate that

- energy comes in different forms
- energy is useful only when it is converted into power
- because energy is lost when it is converted, we need to be able to measure and monitor it

### Before the Program

1. Tell your students this lesson is about the conversion of energy to power, on which all technology depends. Ask them what powers the VCR? *(electricity)* Where does this electrical power come from? *(power plant in which....[source of local power]...is converted to electricity)* Can one kind of energy be changed to another? Why? Say that the video program will address these questions.

2. Ask what an electric meter on a house does? What does it measure? What do the numbers on a light bulb or the horsepower rating of a car engine mean? Tell students that the measurement of energy and power will be discussed in the video. They should think about why such measurements are important.

## TEACHER SUPPLEMENT #1

3. Relate the video program to the students' assignments and lab activities.

4. Tell students to listen for the following terms and careers that will be mentioned in the video program. (You might write them on the chalkboard.)

**Terms**

power
radiant energy
mechanical energy
kinetic energy
work
BTU
radioactive waste
conversion
chemical energy
nuclear energy
power plant
torque
horsepower
Sunraycer®
thermal energy
electrical energy
potential energy
force
pressure
energy efficiency

**Careers**

designer/engineer
maintenance mechanic

**After the Program: Questions for Discussion and Review**

1. Why do we convert energy into power? *(to make it useful)*

2. What are the six forms of energy discussed in the video? *(heat, light, chemical, mechanical, electrical, and nuclear)* Which form of energy is the most portable and most closely associated with stored energy? *(chemical, stored in batteries and fuels, such as gasoline and oil)*

3. Energy is converted from one form to another to meet a specific need. Give an example of the following conversions: a) light to electrical *(photovoltaic cells)*; b) chemical to electrical *(battery)*; c) chemical to thermal *(burning oil for home heat)*; d) electrical to mechanical *(electric motor)*; e) other?

4. Describe the conversions that take place to produce electrical energy to light our laboratory. *(Coal [chemical energy] is burned [thermal energy] to produce steam to turn a turbine [mechanical energy] to produce electricity [electrical energy], which is transmitted to our laboratory light, where the light bulbs convert it to light [radiant energy].* Using the systems model (input, process, output, feedback), describe the energy conversions involved when a person runs. *(**Input**: The food provides the necessary fuel in the form of chemical energy. **Process**: The chemical energy is converted to mechanical energy through the use of muscles. **Output**: The person moves forward. **Feedback**: The body tells the brain if it is tired or needs more fuel.)*

5. What is the difference between "potential energy" and "kinetic energy"? Give an example of each. *(Potential energy is stored energy which is easily converted and available for use as kinetic energy. Kinetic energy is energy in motion. An example of potential energy is water held behind a dam. Kinetic energy is the movement of the water through the gates in the dam.)*

6. What is an example of "wasted energy"? *(heat given off by automobile engines, heat going up a chimney)*

## TEACHER SUPPLEMENT #1

7. Why is it important to measure energy accurately? *(to reduce the energy waste; to determine how much work can be accomplished with the energy available; to convert the right amount of potential energy to kinetic energy)* List the different measurement terms discussed in the video and describe what they measure. *(**force**—any push or pull on an object; **work**—useful motion; results in something being done; **torque**—measures twisting or turning efforts; **pressure**—force per unit of area; **BTU**—measures heat necessary to raise temperature of water; **horsepower**—measure of power)*

8. Nuclear energy produces radioactive waste, causing environmental and health hazards. How can technology solve this problem? *(discussion question)*

# ENERGY CONVERSION AND MEASUREMENT
## UNIT E-2

## TEACHER SUPPLEMENT #2—CROSSWORD PUZZLE

Name ______________________________ Date ________________

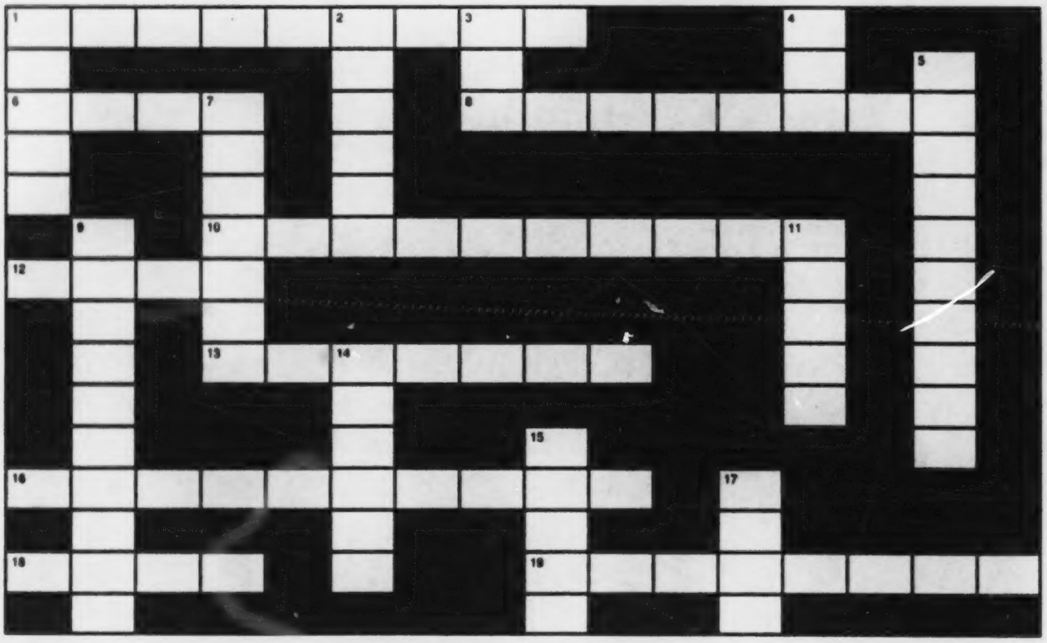
Directions: Use the clues below to solve the puzzle.

ACROSS

1. Energy stored; ready to be used
6. Useful motion
8. Force per unit of area; measured in psi
10. Energy in the form of electron movement
12. Unit for voltage
13. Energy cannot be _____ or destroyed.
16. Process of changing from one form to another
18. Energy from motion of atoms that causes a rise in temperature
19. Energy from fossil fuels

DOWN

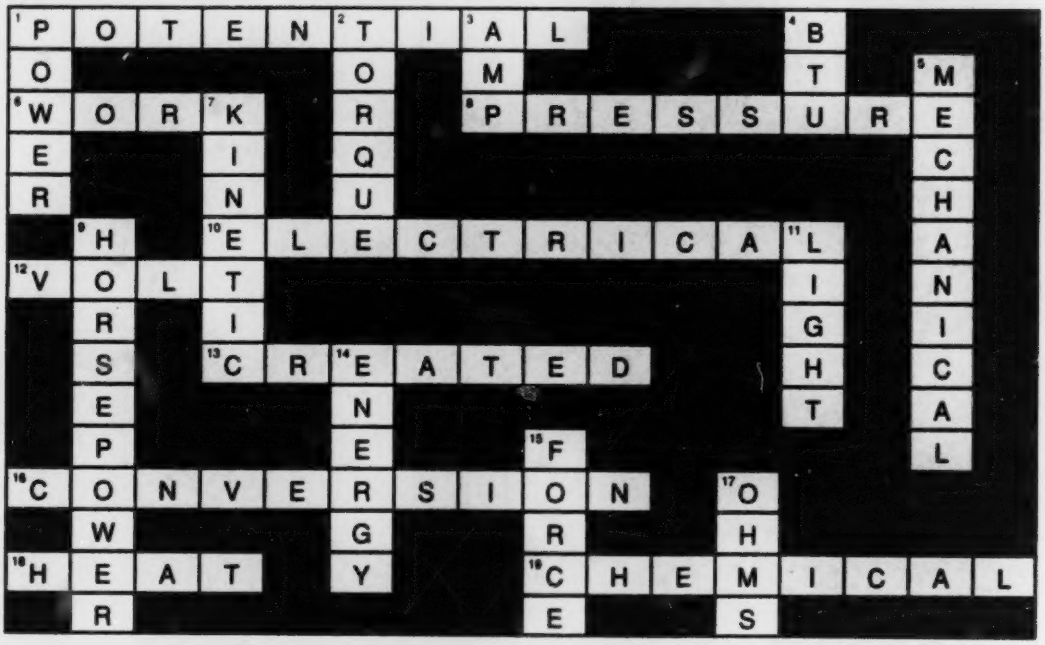
1. Rate at which energy is used
2. Turning or twisting effort
3. Unit for amperage
4. Measures heat
5. Energy of motion; common visible form
7. Category of energy when in motion
9. $\frac{\text{Force} \times \text{Distance}}{\text{Time (sec)} \times 550}$
11. Visible part of radiant energy
14. Capacity to do work
15. Any push or pull on an object
17. Unit for resistance



*Duplication Permitted*

## TEACHER SUPPLEMENT #2

## CROSSWORD PUZZLE ANSWER KEY



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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 P | O | T | E | N | 2 T | I | 3 A | L | | | | 4 B | | | |
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| 6 W | O | R | 7 K | | R | | 8 P | R | E | S | S | U | R | E | |
| E | | | I | | Q | | | | | | | | | C | |
| R | | | N | | U | | | | | | | | | H | |
| | 9 H | | 10 E | L | E | C | T | R | I | C | A | 11 L | | A | |
| 12 V | O | L | T | | | | | | | | | I | | N | |
| | R | | I | | | | | | | | | G | | I | |
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| | R | | | | | | | E | | | S | | | | |

## ENERGY CONVERSION AND MEASUREMENT
## UNIT E-2

## TEACHER SUPPLEMENT #3—WORD SEARCH

Name ______________________________ Date ____________________

Directions: Find the words below hidden in the puzzle. Circle the words that you find.

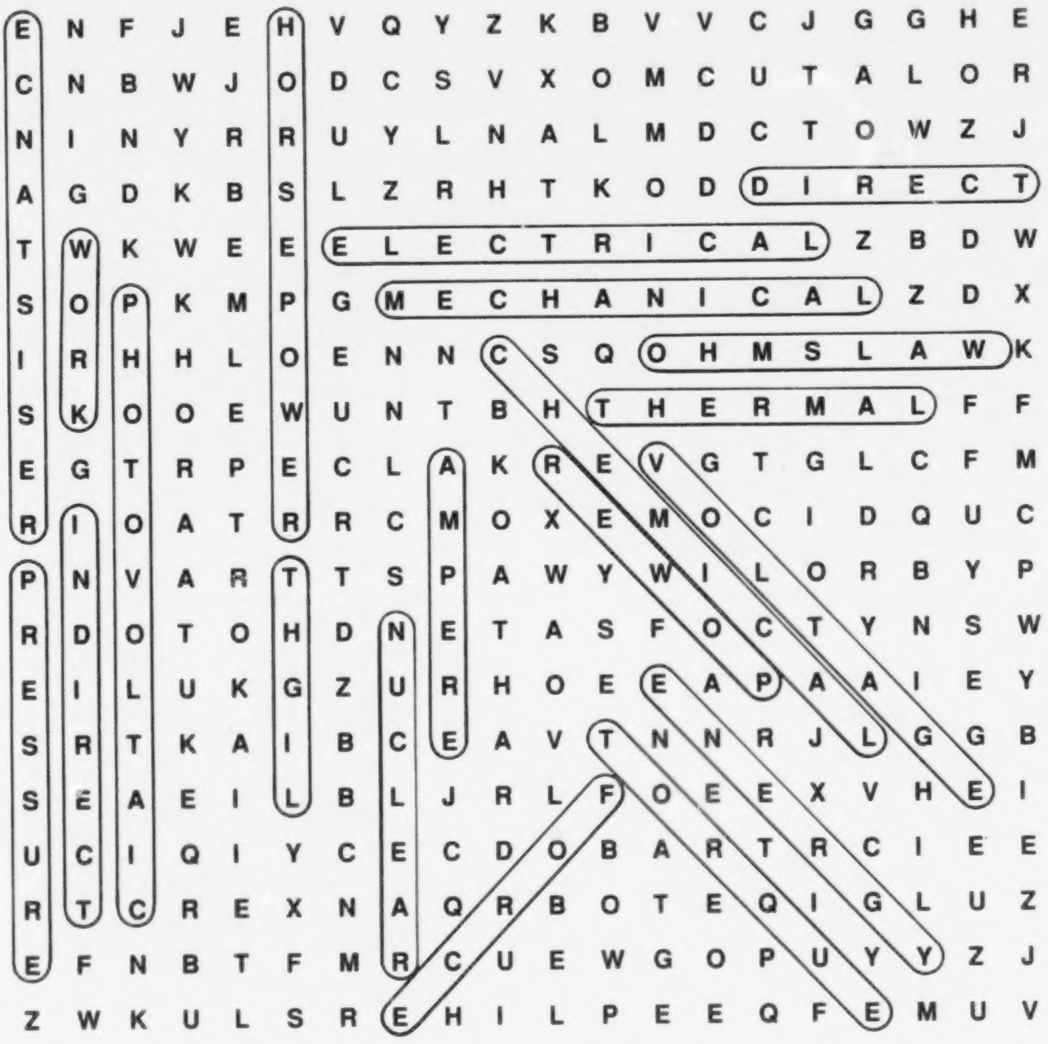
ELECTRICAL
INDIRECT
NUCLEAR
POWER
CHEMICAL
PHOTOVOLTAIC
HORSEPOWER
PRESSURE
ENERGY
THERMAL
OHMS LAW
AMPERE
FORCE
MECHANICAL
TORQUE
RESISTANCE
VOLTAGE
DIRECT
WORK
LIGHT

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E | N | F | J | E | H | V | Q | Y | Z | K | B | V | V | C | J | G | G | H | E |
| C | N | B | W | J | O | D | C | S | V | X | O | M | C | U | T | A | L | O | R |
| N | I | N | Y | R | R | U | Y | L | N | A | L | M | D | C | T | O | W | Z | J |
| A | G | D | K | B | S | L | Z | R | H | T | K | O | D | D | I | R | E | C | T |
| T | W | K | W | E | E | E | L | E | C | T | R | I | C | A | L | Z | B | D | W |
| S | O | P | K | M | P | G | M | E | C | H | A | N | I | C | A | L | Z | D | X |
| I | R | H | H | L | O | E | N | N | C | S | Q | O | H | M | S | L | A | W | K |
| S | K | O | O | E | W | U | N | T | B | H | T | H | E | R | M | A | L | F | F |
| E | G | T | R | P | E | C | L | A | K | R | E | V | G | T | G | L | C | F | M |
| R | I | O | A | T | R | R | C | M | O | X | E | M | O | C | I | D | Q | U | C |
| P | N | V | A | R | T | T | S | P | A | W | Y | W | I | L | O | R | B | Y | P |
| R | D | O | T | O | H | D | N | E | T | A | S | F | O | C | T | Y | N | S | W |
| E | I | L | U | K | G | Z | U | R | H | O | E | E | A | P | A | A | I | E | Y |
| S | R | T | K | A | I | B | C | E | A | V | T | N | N | R | J | L | G | G | B |
| S | E | A | E | I | L | B | L | J | R | L | F | O | E | E | X | V | H | E | I |
| U | C | I | Q | I | Y | C | E | C | D | O | B | A | R | T | R | C | I | E | E |
| R | T | C | R | E | X | N | A | Q | R | B | O | T | E | Q | I | G | L | U | Z |
| E | F | N | B | T | F | M | R | C | U | E | W | G | O | P | U | Y | Y | Z | J |
| Z | W | K | U | L | S | R | E | H | I | L | P | E | E | Q | F | E | M | U | V |

*Duplication Permitted*

## TEACHER SUPPLEMENT #3

### WORD SEARCH ANSWER KEY



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E N F J E H V Q Y Z K B V V C J G G H E
C N B W J O D C S V X O M C U T A L O R
N I N Y R R U Y L N A L M D C T O W Z J
A G D K B S L Z R H T K O D D I R E C T
T W K W E E E L E C T R I C A L Z B D W
S O P K M P G M E C H A N I C A L Z D X
I R H H L O E N N C S Q O H M S L A W K
S K O O E W U N T B H T H E R M A L F F
E G T R P E C L A K R E V G T G L C F M
R I O A T R R C M O X E M O C I D Q U C
P N V A R T T S P A W Y W I L O R B Y P
R D O T O H D N E T A S F O C T Y N S W
E I L U K G Z U R H O E E A P A A I E Y
S R T K A I B C E A V T N N R J L G G B
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U C I Q I Y C E C D O B A R T R C I E E
R T C R E X N A Q R B O T E Q I G L U Z
E F N B T F M R C U E W G O P U Y Y Z J
Z W K U L S R E H I L P E E Q F E M U V
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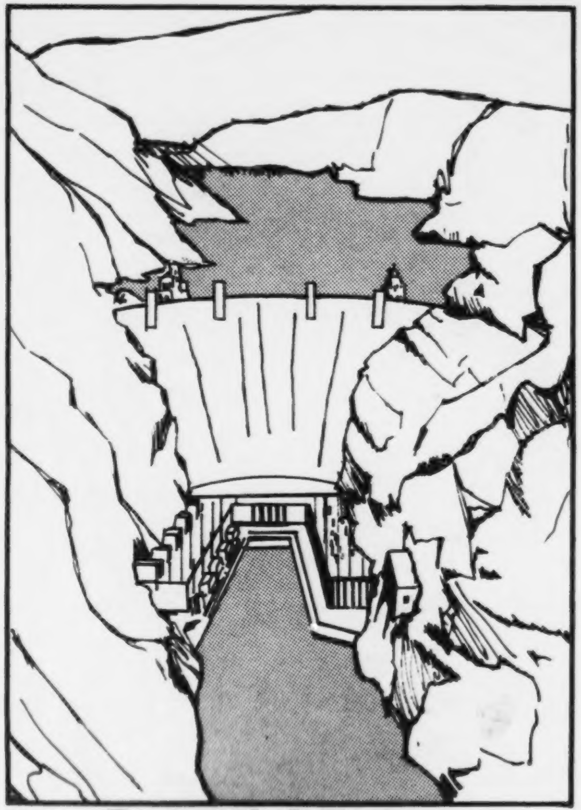
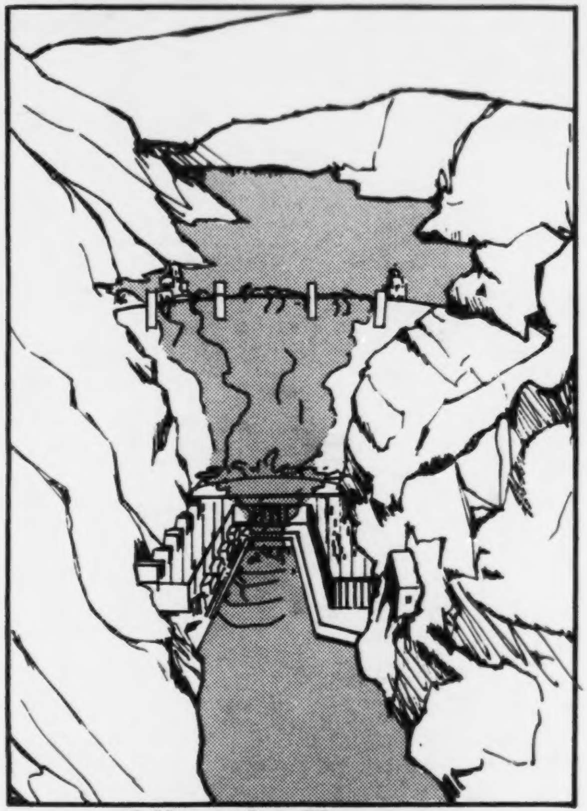
# Categories of Energy

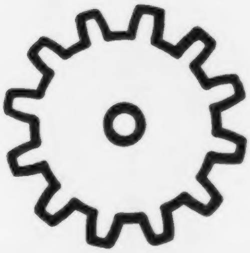


**Potential Energy**
(Energy Stored)
Water Behind a Dam

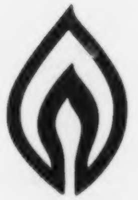


**Kinetic Energy**
(Energy in Motion)
Water Released From a Dam

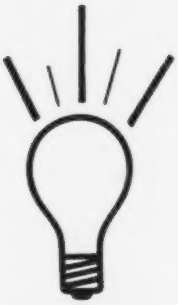
# Forms of Energy



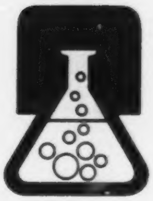
**Mechanical**



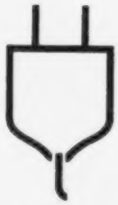
**Heat**



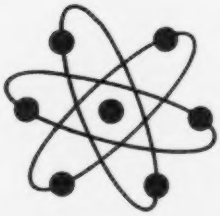
**Light**



**Chemical**



**Electrical**



**Nuclear**

## ENERGY CONVERSION AND MEASUREMENT
## UNIT E-2

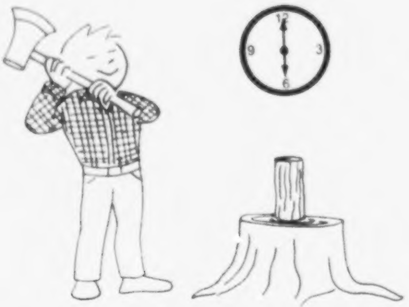
## INFORMATION SHEET

I. **Terms and definitions**

A. Ampere — A unit of measurement for the rate of electrical current flow

B. Conversion — The process of changing from one form to another

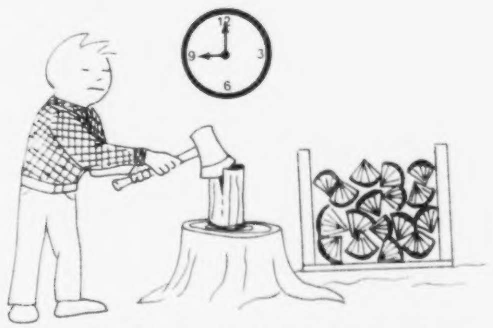
C. Energy — Capacity to do work



**Energy**

D. Photovoltaic — Devices that convert sunlight directly into electricity

E. Power — Rate at which energy is used; work divided by time



**Power**

F. Resistance — The opposition to electrical current flow

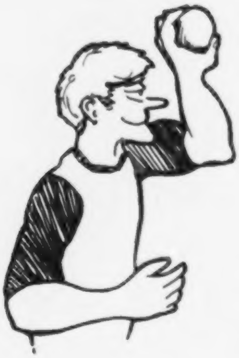
G. Voltage — The force necessary to move electrons from one atom to another in a material

## INFORMATION SHEET

### II. Categories of energy

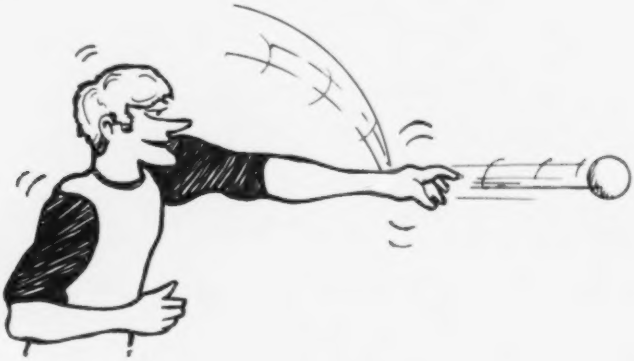
A. Potential — Energy stored, or energy ready to be used or availab se.

Example:



B. Kinetic — Energy in motion, or the ability of objects that are mo do work.

Example:

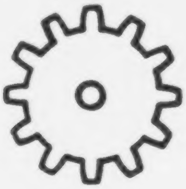


## INFORMATION SHEET

### III. Forms of energy

A. Mechanical energy — The energy of motion; the most common and visible form of energy

Examples: Turning a wrench or key, climbing stairs, engine turning a crankshaft and wheels



**Mechanical**

B. Heat (thermal) energy — The motion of atoms or molecules that causes a rise in temperature. The faster they move, the more heat they produce.

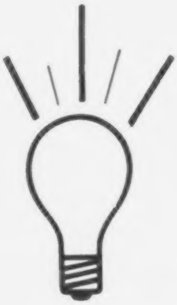
(NOTE: Heat is present whenever there is motion.)

Example: The movement of a hot air balloon is a visible effect of thermal energy. The "fuel" for the balloon is the heated air. As the hot air rises, so does the balloon.

**Heat**

C. Light energy — The visible part of radiant energy consisting of electromagnetic waves traveling through space

Example: The use of a light bulb to see at night

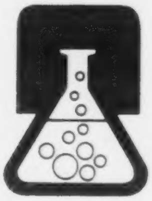


**Light**

## INFORMATION SHEET

D. Chemical energy — Energy produced by chemical changes; the source of energy for all living things

Example: Fossil fuels



**Chemical**

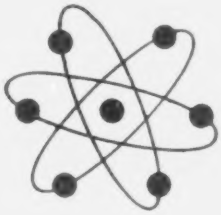
E. Electrical energy — The motion of tiny invisible particles of matter called electrons

Example: Movement of electrons converted to light, heat, or motion

**Electrical**

F. Nuclear energy — Energy produced by reactions in the nuclei of atoms

Example: Splitting or combining atoms of uranium



**Nuclear**

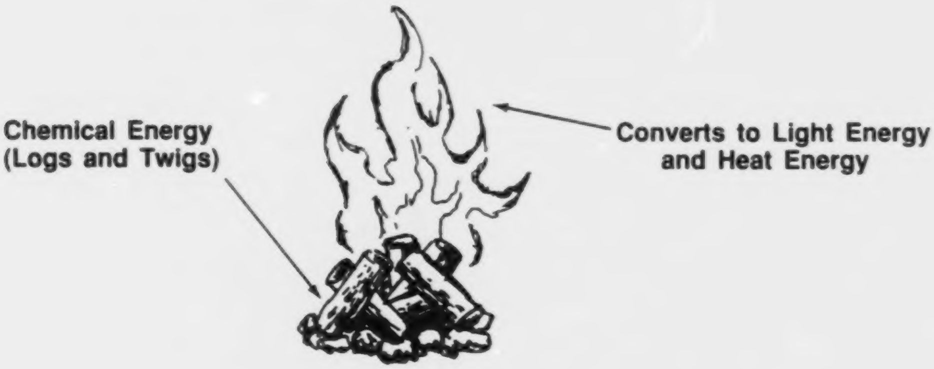
## INFORMATION SHEET

### IV. Characteristics of energy

A. Energy, generally, cannot be created or destroyed.

(NOTE: When we say energy is being used, it is not being used up or destroyed. It still exists in some state or form.)

B. Energy can be converted from one form to any other form.



1. We are usually trying to convert potential energy into kinetic energy.
2. We commonly use generating plants and various types of engines to make these energy conversions.
3. Examples of conversions include
    a. Exercise — Chemical energy (food) converts to mechanical energy (motion) and heat energy.

    b. Photoelectric cells — Sun (light and heat energy) converts to electricity (electric energy).

    c. Electric generating plant — Chemical energy (fuel) converts to heat energy when burned which is applied to water to produce steam (mechanical energy) which drives a turbine (mechanical energy) which operates a generator which converts energy to electricity (electrical energy) which travels to a home to operate a light bulb (light energy).

    d. Electric stove — Supplied electrical energy converts to heat energy

    e. Flashlight battery — Chemical energy converts to electrical energy to light energy

## INFORMATION SHEET

V. **Types of conversions**

A. Direct conversion — When energy is used after only one conversion

Example: Solar cells convert sunlight directly into electricity

B. Indirect conversion — When several conversions must take place before the energy is in the right form to do work.

Example: Automobile engines convert fuel (chemical energy) into heat energy for combustion then into mechanical energy to move gears and wheels; may also be converted to electrical energy then to light energy by headlights.

VI. **Measuring energy and power**

(NOTE: As people learned to control energy, they developed ways to measure energy and power. By using measurements we can find out how much energy we need to perform a task.)

A. Force

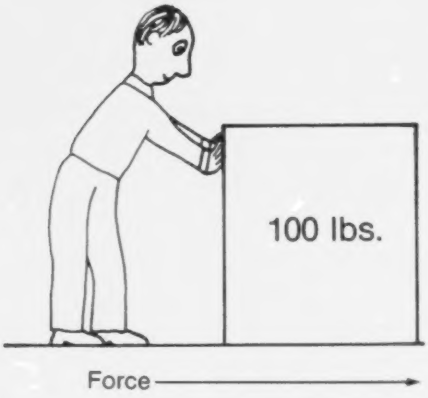
1. Definition: Any push or pull on an object

   (NOTE: Weight is force applied in a vertical {up and down} direction.)

2. Units of measurement

   a. U.S. standard — Pounds (lbs)

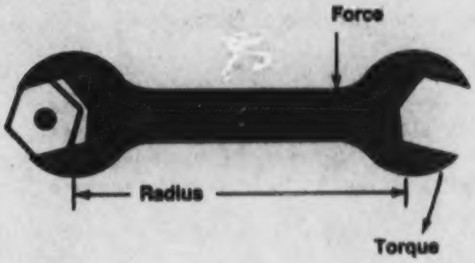
   b. Metric — Newtons (N)



## INFORMATION SHEET

B. Torque

1. Definition: Turning or twisting effort
2. Formula: Torque = Force x Radius
3. Units of measurement
    a. U.S. standard — Pound-feet (lb-ft)
    b. Metric — Newton-meters (N-m)



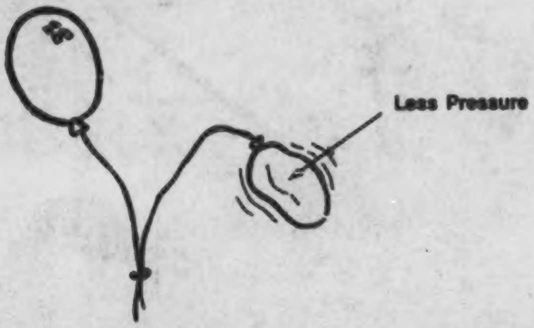
C. Pressure

1. Definition: Force per unit of area
2. Formulas: Area = Length x Width

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

3. Units of measurement
    a. U.S. standard — Pounds per square inch (psi)
    b. Metric — Pascals (Pa) or Kilopascals (kPa)

(NOTE: Units of pressure are normally used to measure the force exerted by fluids (gases or liquids).)



## INFORMATION SHEET

D. Work

1. Definition: Useful motion or motion that results in something useful being done; measurement of mechanical energy

   Examples: Movement of a vehicle, movement of boxes

   (NOTE: There is no work if nothing is accomplished. If you tried to move a boulder and could not move it at all, you have not performed any work. You may have exerted energy, but you did not perform any work because there was no useful motion.)

2. Formula: Work = Force x Distance

3. Units of measurement

   a. U.S. standard — Foot-pounds (ft-lbs)

   b. Metric — Joules (j) or Newton-meters (N-m)

E. Horsepower

1. Definition — The unit of measure for power. One hp equals the energy needed to lift 550 lbs. 1 foot in 1 second, or 33,000 lbs. 1 foot in 1 minute.

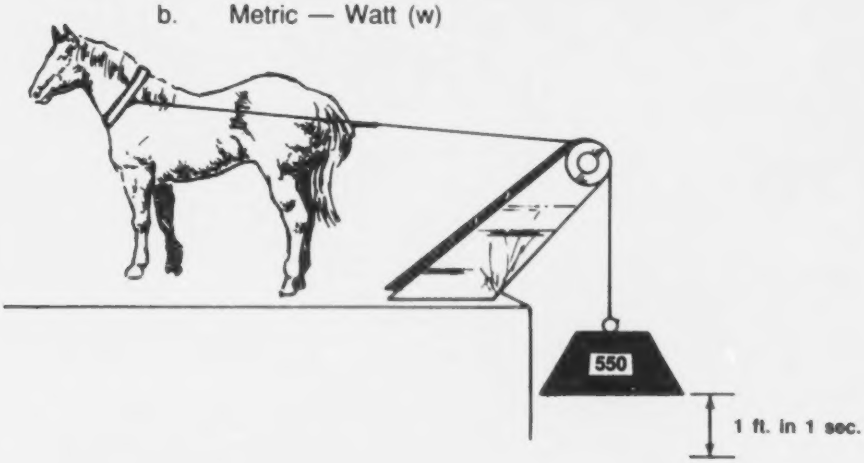
2. Formulas —

$$\text{horsepower} = \frac{\text{Force} \times \text{Distance}}{\text{Time (seconds)} \times 550} \quad \text{or} \quad \frac{\text{Force} \times \text{Distance}}{\text{Time (minutes)} \times 33{,}000}$$

3. Units of measurement

   a. U.S. standard — Horsepower (hp)

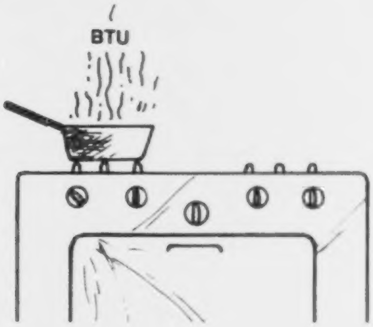
   b. Metric — Watt (w)



## INFORMATION SHEET

F. Thermal units

1. British Thermal unit (BTU) definition: The heat needed to raise the temperature of 1 pound of water 1 degree Fahrenheit
2. Calorie (Cal) definition: The heat needed to raise the temperature of one kilogram of water 1 degree Celsius
3. Units of measurement
    a. U.S. standard—BTU
    b. Metric—Calorie

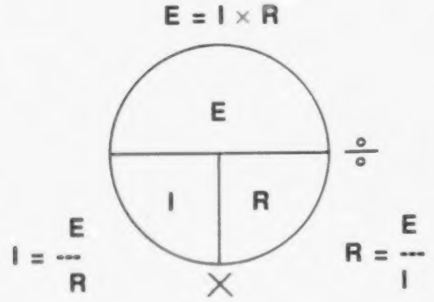


G. Electrical units

1. Definition: Ohm's law states that voltage (E) equals resistance (R) multiplied by amperage (I)
2. Units of measurement
    a. Volt — Unit for voltage
    b. Amp — Unit for amperage
    c. Ohm — Unit for resistance
3. Formulas
    a. Voltage (E) = Resistance (R) × Amperage (I)
    b. $\text{Resistance (R)} = \dfrac{\text{Voltage (E)}}{\text{Amperage (I)}}$

## INFORMATION SHEET

c. Amperage (I) = $\dfrac{\text{Voltage (E)}}{\text{Resistance (R)}}$


E = I × R
E
÷
I
R
I = E/R
×
R = E/I

**Ohm's Law**

## ENERGY CONVERSION AND MEASUREMENT
## UNIT E-2

### ASSIGNMENT SHEET #1—IDENTIFY ENERGY CONVERSIONS

Name ________________________________________ Overall Rating ______________

| EVALUATION CRITERIA | RATING |
|---|---|
| Answers are correct | ______ |
| Assignment is neat and completed on time | ______ |

Directions: Identify the forms of energy as they are converted in the following situations.

1. Electricity generation from coal — When coal (a.______________ energy) is burned, it converts to b.______________ energy. This converts water to steam which turns (c.______________ energy) a turbine connected to a generator that converts it now to d.______________ energy to be transmitted to homes and businesses for electricity.

2. Hydroelectric power for lighting — Falling water (a.______________energy) turns (b.____________energy) a turbine connected to a generator that converts it to c.____________ energy that operates household lamps (d.__________ energy).

3. Trees to firewood — Trees collect a.__________ energy and b.__________ energy from the sun and convert it to c.______________ energy. Trees are cut and used as firewood which produces d.______________ energy and e.______________ energy.

## ENERGY CONVERSION AND MEASUREMENT
## UNIT E-2

### ASSIGNMENT SHEET #2—SOLVE PROBLEMS INVOLVING ENERGY AND POWER MEASUREMENTS

Name ______________________________ Overall Rating ______________

| EVALUATION CRITERIA | RATING |
|---|---|
| Answers are correct | ______ |
| Assignment is neat and completed on time | ______ |

Directions: Use the formulas from the information sheets to solve the following problems. Calculators are allowed.

(NOTE: Round answers to nearest hundredth.)

1. What is the torque if a force of 25 pounds is applied to a wheel 30 inches in diameter?

   Answer: ______________________________

2. It takes 55 pounds of force to move a 200-pound box 20 feet across the floor. How much work is accomplished?

   Answer: ______________________________

3. If a force of 20 pounds is applied to a wrench 8 inches long, how much is the torque?

   Answer: ______________________________

4. A 125-pound woman climbs a 40-foot flight of stairs in 20 seconds. How much power does she develop performing the task?

   Answer: ______________________________

5. How much work is accomplished if it takes 100 pounds of force to move a 350-pound object 12 feet?

   Answer: ______________________________

6. A 2-ton weight is moved a distance of 50 feet across the floor. The force necessary to move the weight is 200 pounds and the time required is two minutes. How much power is required to perform this task?

   Answer: ______________________________

## ASSIGNMENT SHEET #2

7. What is the pressure inside a balloon with a force of 50 lbs. and an area of 10 square inches?

   Answer: ______________________________

8. An electric circuit has a voltage reading of 6 volts and resistance of 2 ohms. What is the number of amps?

   Answer: ______________________________

9. An electric motor is powered by a 110 volt outlet. The circuit amperage is 20 amps. What is the value of the resistance?

   Answer: ______________________________

10. An electronic calculator has a resistance of 2 ohms and ampere reading of .5 amps. What is the total voltage required to operate the calculator?

    Answer: ______________________________

## ENERGY CONVERSION AND MEASUREMENT
## UNIT E-2

## ANSWERS TO ASSIGNMENT SHEETS

### Assignment Sheet #1

1. a. Chemical
   b. Heat
   c. Mechanical
   d. Electrical

2. a. Mechanical
   b. Mechanical
   c. Electrical
   d. Light

3. a. Light (or heat)
   b. Heat (or light)
   c. Chemical
   d. Heat (or light)
   e. Light (or heat)

### Assignment Sheet #2

1. 375 lb.-ft.
2. 1100 ft.-lbs.
3. 160 lb.-ft.
4. .45 hp
5. 1200 ft.-lbs.
6. .15 hp
7. 5 psi
8. 3 amps
9. 5.5 ohms
10. 1 volt

# ENERGY CONVERSION AND MEASUREMENT
## UNIT E-2

## LAB ACTIVITY SHEET #1—CONSTRUCT AN ELECTRICAL CONVERSION SIMULATOR

Name ______________________________ Overall Rating ______________

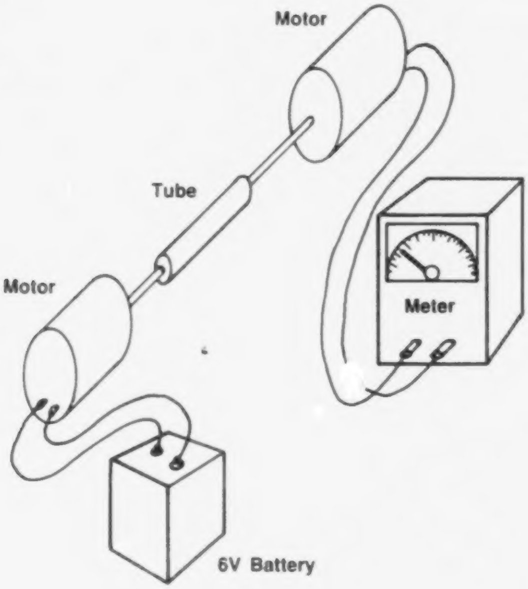
| EVALUATION CRITERIA | RATING |
|---|---|
| Procedure is followed correctly | _____ |
| Readings are correct | _____ |
| Question is answered correctly | _____ |
| Construction is neat | _____ |
| Simulator operates correctly | _____ |
| Activity is completed on time | _____ |

Directions: Construct an electrical conversion simulator to demonstrate the characteristics of energy conversion and power loss.

A. Materials needed:

- 2-electric motors
- 1-multimeter
- 1-1.5 & 6 volt battery
- 1-6 volt LED
- 1-hot glue system
- 4-wires (6")
- 1-½" long plastic tube (inside diameter equal to diameter of motor shaft)
- 1-pre-cut wood block

B. Procedure:



## LAB ACTIVITY SHEET #1

1. Connect the two motors by the shafts with the plastic tube.
2. Attach two separate wire leads (four wires) to each motor.
3. Use hot glue to attach the motors to the pre-cut wood block.
4. Connect the 1.5 volt battery to the leads of one of the electric mc
5. Use the multimeter to check the voltage output reading from the le the other motor.
6. Record the voltage reading below.

   First Reading ______________________________

7. Connect the 6 volt battery to the leads of one of the electric motc
8. Use the multimeter to check the voltage output reading from the le the other motor.
9. Record the voltage reading below.

   Second Reading ______________________________

10. Connect the LED to the leads of one of the electric motors.
11. What happens to the LED?

    ______________________________

    ______________________________

    ______________________________

## ENERGY CONVERSION AND MEASUREMENT
## UNIT E-2

### LAB ACTIVITY SHEET #2—CONSTRUCT A THERMAL CONVERSION SIMULATOR

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Procedure is followed correctly | ______ |
| Construction is neat | ______ |
| Simulator operates correctly | ______ |
| Activity is completed on time | ______ |

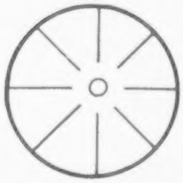
Directions: Construct a thermal conversion simulator to demonstrate how energy forms can be converted.

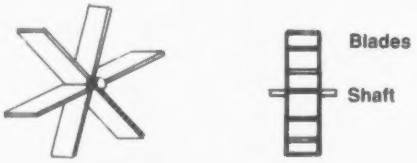
A. Materials needed:

1-electric motor
1-⅛" drill bit & drill
1-aluminum roof flashing
1-1.5 volt LED
1-hot glue system
1-hot plate burner
1-⅛" straw
1-band or scroll saw
2-wires (10")
1-beaker and stopper
1-16" rubber hose
2-wood blocks (½" thick x 6" sq.)
1-⅛" welding or dowel rod
1-metal pan
1-plastic tube (⅛" inside diameter)

B. Procedure:

1. Use the pattern (below) to shape the turbine for the thermal conversion demonstrator. Drill an ⅛" hole in the center of the turbine.

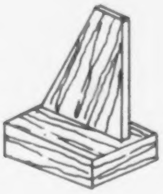

Pattern with 8 Divisions



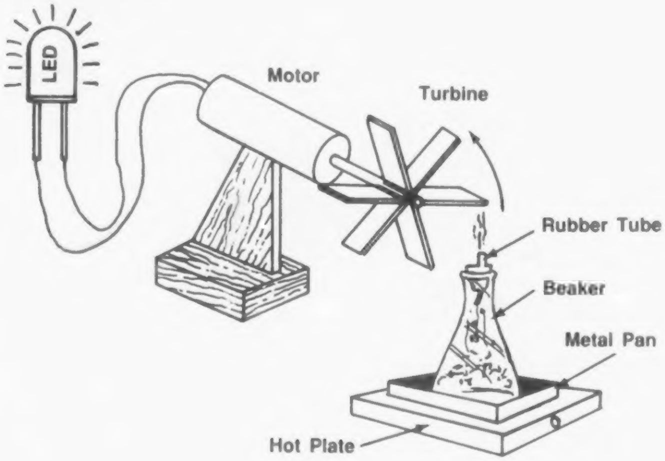
Shaped into Turbine Blades

## LAB ACTIVITY SHEET #2

2. Prepare the two wood blocks as shown below and attach with hot glue.



3. Fasten the ⅛" x 4" rod to the turbine with hot glue.
4. Place one end of the ⅛" plastic tube on the end of the shaft connected to the turbine. Attach the other end of the tube to electric motor shaft.
5. Attach the wire leads to the electric motor.
6. Attach the other end of the wire leads to the LED.
7. Turn the hot plate on and place the metal pan on the burner.
8. Fill the beaker with water and place beaker in the pan on the burner.
9. Place rubber hose in beaker stopper and use the stopper to seal the beaker.
10. Use hot glue to fasten the other end of the rubber hose underneath the turbine blades.



## LAB ACTIVITY SHEET #2

11. Observe the conversion processes taking place.
    - a. Electricity (electrical) to power the burner.
    - b. Heat (thermal) from burner to produce steam.
    - c. Steam turns the turbine (mechanical).
    - d. Turbine turns the electric motor (mechanical).
    - e. Motor produces electricity (electrical).
    - f. Electricity converts into light (light).

## ENERGY CONVERSION AND MEASUREMENT
## UNIT E-2

## TEST

Name ______________________________ Score ____________________

1. Match the terms on the right with the correct definitions.

______a. Capacity to do work

______b. The process of changing from one form to another

______c. A unit of measurement for the rate of electrical current flow

______d. The opposition to electrical current flow

______e. Rate at which energy is used

______f. The force necessary to move electrons from one atom to another in a material

1. Ampere
2. Conversion
3. Energy
4. Photovoltaic
5. Power
6. Resistance
7. Voltage

2. Distinguish between the categories of energy by placing a "P" for Potential or a "K" for Kinetic in the proper blanks.

______a. Energy in motion, or the ability of objects that are moving to do work

______b. Energy stored, or energy ready to use or available for use

3. Match the forms of energy on the right with the correct descriptions.

______a. The energy of motion; the most common and visible form of energy

______b. The visible part of radiant energy consisting of electromagnetic waves traveling through space

______c. Energy produced by chemical changes; the source of energy for all living things

______d. The motion of tiny invisible particles of matter called electrons

______e. Energy produced by reactions in the nuclei of atoms

1. Heat
2. Electrical
3. Nuclear
4. Light
5. Mechanical
6. Chemical

## TEST

4. Complete the following statements concerning characteristics of energy by circling the correct words.

   a. Energy (can, can not) be created or destroyed.

   b. Energy (can, can not) be converted from one form to another form.

   c. We are usually trying to convert (kinetic, potential) energy into (kinetic, potential) energy.

   d. An example of conversion would be (exercise, an electric motor) in which chemical energy converts to mechanical energy and thermal energy.

5. Distinguish between the types of conversions by placing a "D" for direct conversion and an "I" for indirect conversion next to the correct descriptions.

   ______a. When several conversions must take place before the energy is in the right form to do work

   ______b. When energy is used after only one conversion

6. Complete the following statements concerning the measurement of energy and power by placing the correct number designations in the appropriate blanks.

   ______a. Any push or pull on an object is ______.

   1) Pressure
   2) Force
   3) Work

   ______b. The standard U.S. unit of measurement for work is ______.

   1) Pound
   2) Horsepower
   3) Foot-pound

   ______c. The standard U.S. unit of measurement for power is ______.

   1) Pound
   2) Horsepower
   3) Foot-pound

   ______d. ______ is useful motion or motion that results in something useful being done.

   1) Work
   2) Force
   3) Pressure

## TEST

______e. British thermal unit is the heat needed to raise the temperature of one ______ of water one degree Fahrenheit.

1) Ounce
2) Liter
3) Pound

______f. $\_\_\_\_\_\_ = \frac{\text{Force}}{\text{Area}}$

1) Torque
2) Work
3) Pressure

______g. Ohm's law states that voltage equals ______ times amperage.

1) Force
2) Resistance
3) Watts

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

7. Identify energy conversions. (Assignment Sheet #1)
8. Solve problems involving energy and power measurements. (Assignment Sheet #2)
9. Construct an electrical conversion simulator. (Lab Activity Sheet #1)
10. Construct a thermal conversion simulator. (Lab Activity Sheet #2)

## ENERGY CONVERSION AND MEASUREMENT
## UNIT E-2

## ANSWERS TO TEST

1. a. 3
   b. 2
   c. 1
   d. 6
   e. 5
   f. 7

2. a. K
   b. P

3. a. 5
   b. 4
   c. 6
   d. 2
   e. 3

4. a. Can not
   b. Can
   c. Potential, kinetic
   d. Exercise

5. a. I
   b. D

6. a. 2
   b. 3
   c. 2
   d. 1
   e. 3
   f. 3
   g. 2

7.-10. Evaluated to the satisfaction of the instructor

# POWER TRANSMISSION, CONTROL, AND STORAGE
## UNIT E-3

### UNIT OBJECTIVE

After completion of this unit, the student should be able to identify simple machines and control devices, determine the mechanical advantage of simple machines, and design and build a model racer. Competencies will be demonstrated by completing the assignment sheets, lab activity sheet, and unit test with a minimum score of 85 percent.

### SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match the terms related to power transmission, control, and storage with the correct definitions.
2. Match the types of power systems with the correct descriptions.
3. Distinguish between the types of fluid power systems.
4. Complete statements concerning electrical power system devices.
5. List examples of thermal power systems.
6. Identify types of motion.
7. Identify types of simple machines for transmitting mechanical power.
8. Select from a list functions of machines.
9. Identify types of drives for transmitting and controlling mechanical power.
10. Complete statements concerning storing potential and kinetic energy.
11. Determine mechanical advantage of simple machines. (Assignment Sheet #1)
12. Calculate velocity and miles per hour. (Assignment Sheet #2)
13. Design a model racer. (Assignment Sheet #3)
14. Build a model racer. (Lab Activity Sheet #1)

## POWER TRANSMISSION, CONTROL, AND STORAGE
## UNIT E-3

### SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher edition only and are designed to be used with the following objectives:

TM 1-3 — Electrical Power Devices — Objective 4
TM 4-5 — Simple Machines — Objective 7
TM 6 — Mechanical Drives — Objective 9

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Provide students with lab activity sheet.

H. Discuss and demonstrate the procedure outlined in the lab activity sheet.

I. Integrate the following activities throughout the teaching of this unit:

1. Use Teacher Supplement #1 to present AIT video E-3. This video was developed by the Agency for Instructional Technology (AIT) and a consortium of states to accompany this publication. Contact your state supervisor of technology education for copies, or contact AIT directly for more information:

   Agency for Instructional Technology (AIT)
   Box A, Bloomington, IN 47402
   800-457-4509 or 812-339-2203

2. Use Teacher Supplements #2 and #3 to help students understand this unit's terminology. Make copies (fronts only) for your students. The answers are on the backs of the supplements.

3. Show videos and/or films on hydraulics, pneumatics, robotics, and other power transmission methods.

4. Have students bring pictures of examples of how hydraulics and pneumatics are used in today's technology from newspapers and magazines for display.

## SUGGESTED ACTIVITIES

5. Arrange a field trip to view fluid devices on heavy construction equipment.

6. Mechanical, hydraulic, pneumatic, and robotic trainers may be used in this unit.

7. Use syringes, plastic tubing, and other materials to build a robotic arm. Demonstrate the principles of hydraulic and pneumatic movement.

8. Construct a wind tunnel to test the student-designed cars.

9. You may wish to have students build their race cars from their original designs or from kits. Kits may be purchased from the following:

   Pitsco, Inc.
   Box 1328
   Pittsburg, KS 66762

10. TSA, the Technology Student Association, sponsors "Metric 500" races as a competitive event. Discuss with students whether or not they would like to compete.

11. Design and build a model manufacturing system utilizing all four power systems.

12. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

J. Give test.

K. Evaluate test.

L. Reteach if necessary.

## REFERENCES USED IN DEVELOPING THIS UNIT

A. Bohn, Ralph C., et. al. *Energy, Power, and Transportation Technology.* Peoria, IL: Bennett & McKnight, 1986.

B. Groneman, Chris H. and John L. Feirer. *General Industrial Education and Technology*, 7th ed. New York: McGraw-Hill, 1986.

C. Karwatka, Dennis and Michael R. Kozak. *Discovering Technology: Energy, Power, and Transportation.* Orlando, FL: Harcourt Brace Jovanovich, 1987.

D. Schwaller, Anthony. *Transportation, Energy, and Power Technology.* Albany, NY: Delmar Publishers, Inc., 1989.

## SUGGESTED ACTIVITIES

## SUGGESTED SUPPLEMENTAL RESOURCES

A. Films

1. *Mechanics of Fluids: Fundamental Principles of Flow* (23 min. color)

2. *Fluid Flow in Hydraulic Systems* (10 min. color)

University of Illinois
Visual Aids Service
1325 South Oak Street
Champaign, IL 61820

B. Videos

1. *For Years to Come*, Chrysler Corporation. (26 min.) Available in 16 mm, "U-Matic, "Beta," or "VHS" from the following:

Marathon International Productions, Inc.
211 East 51st Street
New York, NY 10022

2. *Believing the Dream*, (20 min.), 1986. Documents the designing and testing of a dragster and the development of a vocational student organization competitive event around the dragster. Available from:

Pitsco, Inc.
Box 1328
Pittsburg, KS 66762

3. *Paths of Power* (12 min. color)

4. *Electronics...Your Bridge to Tomorrow* (17 min.)

5. *Your Future: Careers in Instrumentation and Control* (16 min.)

6. *Steam People* (20 min.)

3-6 are available from:

Modern Talking Picture Service
Attn: Client Service
5000 Park Street North
St. Petersburg, FL 33709-9989

## SUGGESTED ACTIVITIES

7. *Transmission, Control, and Storage of Power* (12 min.) Available from:

   Agency for Instructional Technology
   Box A
   Bloomington, IN 47402
   800-457-4509

# POWER TRANSMISSION, CONTROL, AND STORAGE
## UNIT E-3

## TEACHER SUPPLEMENT #1—USING AIT VIDEO E-3

### Introduction and Program Summary (12:06)

This program presents the need for controlling power, systems for transmitting it, and ways of storing it.

Opening with a scene of a Hovercraft®-like vehicle built by technology students, the program emphasizes that to use power, we must control it. Controlling it often means stopping, starting, or changing the direction of a force. Control of power is needed in all four technical areas—communication, construction, manufacturing, and transportation. To control it, however, we also need to be able to transmit it. The program introduces and demonstrates four transmission systems: mechanical, fluid, electrical, and thermal. An engineer explains how his model blimp uses various power transmission systems, while fighter planes on an aircraft carrier use very complex systems to control and transmit power. An automobile mechanic explains how the failure of a car to start can involve any of the four systems for transmitting power.

Often power must be stored. The program shows examples of electrical, fluid, thermal, and mechanical storage systems. It then returns to the Hovercraft® vehicle, which the students are testing. Their control system is not perfect, and they have difficulty steering it. In the future superconductivity and lasers may help us find new ways to control and transmit power.

### Video Program Objectives

The video program will illustrate that

- power must often be transmitted to do useful work
- to be used effectively, power must be controlled
- power can be stored for later use

### Before the Program

1. Tell your students this lesson discusses the importance of being able to transmit, control, and store power. Point to the different control devices on the VCR and TV (on-off switch, volume, brightness). Ask what would happen if we were unable to control the power in these devices? What would happen if electrical energy was no longer transmitted to our town or homes? What products do students have that require the use of stored energy? *(watch, radio, camera, calculator)*

2. Tell students what they will be doing in the lab, and how the content of the video program will set the stage for the laboratory activity.

## TEACHER SUPPLEMENT #1

3. Tell students to note the following in the video program: the impor controlling power; examples of controlling power in the different tec areas; four kinds of power transmission systems; future methods of tran power and how they will affect us.

4. Tell students that the following terms and careers will be mentione video program. (You might write them on the chalkboard.)

**Terms**

Hovercraft®
mechanical systems
thermal systems
superconductor
control
fluid systems
blimp
transmission
electrical systems
laser

**Careers**

engineer
automotive mechanic

### After the Program: Questions for Discussion and Review

1. Control devices are used in power systems to change movement tc usable form. What are the most common changes? *(on-off switching, of direction, speed, or force)*

2. What are examples of the need to control energy and power in manufa In construction? In communication? In transp *(**manufacturing**—change speed of drills or temperature for pr materials; **construction**—controlling the flow of water and electricity in **communication**—strength of signals broadcast from a radio station o of light for processing film; **transportation**—forward and revers steering, braking or accelerating, turning on or shutting down the ig*

3. What are the four power systems for controlling and transmitting po were discussed in the video program? *(mechanical, fluid, electri thermal power systems)*

4. What are examples of power being controlled or transmitted in systems? *(**mechanical**—pulleys, belts, gears, brakes; **fluid** transmission lines, cylinders and motors; **electrical**—switches and re conductors and insulators, solenoids and motors; **thermal**—conduc insulation)*

5. What systems were demonstrated with the model blimp? *(me electrical, and fluid)*

6. What was the purpose of controlling power for launching and landin on the aircraft carrier? How did they do it? *(A catapult provided speed to launch the aircraft safely, and a tail hook on the aircraft cable, transferring the energy of forward motion to the cable to stop t quickly enough to land safety and successfully.)*

## TEACHER SUPPLEMENT #1

7. Discuss the Hovercraft® in terms of how it worked and what needs to be done for it to work better. *(discussion topic)*

8. What energy storage devices are associated with the different power systems? *(**mechanical system**—coiled springs; **fluid system**—compressed air tanks; **electrical system**—batteries, solenoids, and motors; **thermal system**—chemical energy stored in matches, charcoal, and other fuels.)*

9. How has the ability to control and transmit power affected our way of living? How will power be transmitted in the future? *(Possible answers to these discussion questions include lasers and superconductors.)* Would we have any use for heat as hot as the sun? *(Let students speculate.)*

## POWER TRANSMISSION, CONTROL, AND STORAGE
## UNIT E-3

### TEACHER SUPPLEMENT #2—CROSSWORD PUZZLE

Name ________________________________ Date ________________

Directions: Use the clues below to solve the crossword puzzle.

ACROSS

1. Type of simple machine used with an axle
5. Pivot point
6. Generate direct current
7. ______ plane
9. Conducts current without resistance
11. Increase in speed
15. Circular motion
17. Electrical overload device
18. Power system that moves heat
21. Pneumatic fluid
23. Speed of an object
24. Type of drive used with pulleys
25. Type of drive with mating teeth
26. Motion in a straight line

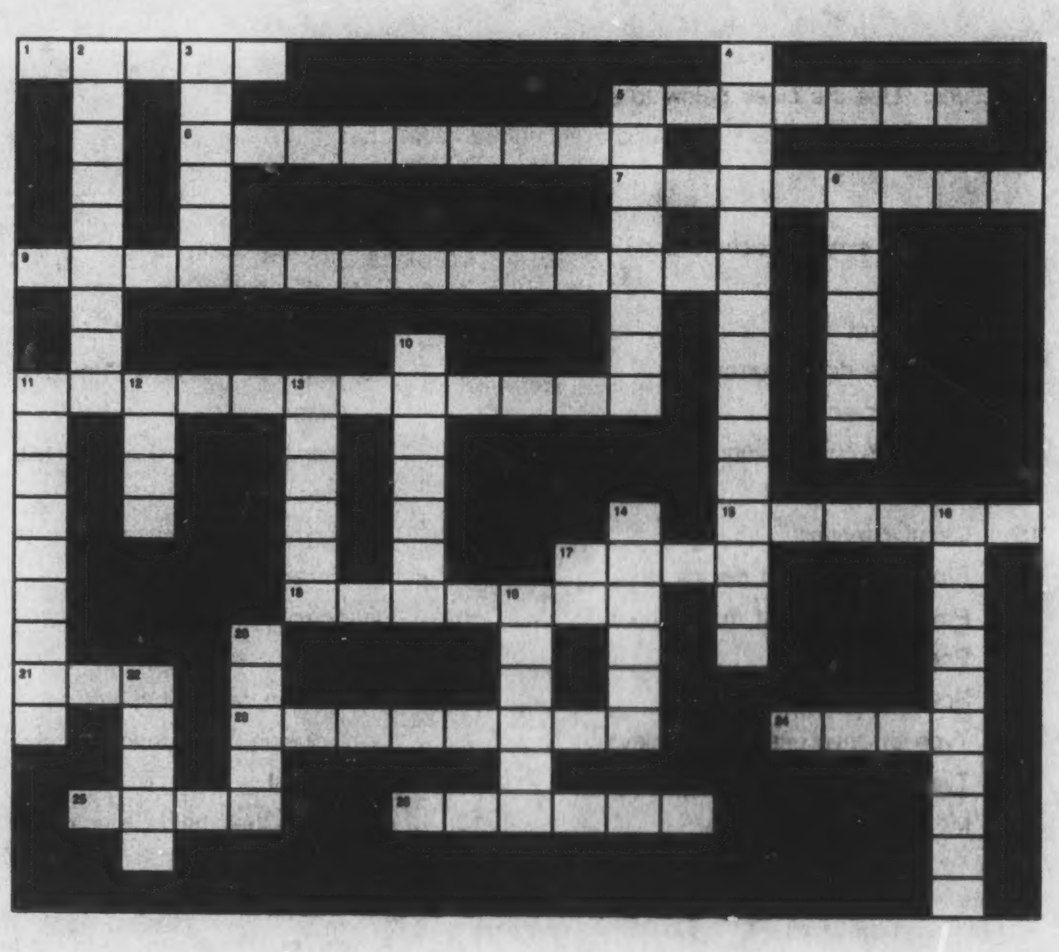
DOWN

2. Fluid power using liquids
3. Converts energy into mechanical energy
4. Movement of electrons through a conductor
5. Resistance to motion between two surfaces in contact
8. Tendency of object at rest to remain at rest
10. Changes the relationship between force and speed
11. Increase in force that you gain from using a machine — Mechanical ________
12. Container that holds electrodes and electrolytes
13. Force applied to the machine
14. Simple machine with dead and live blocks
16. Force overcome by the machine
19. Rotary and linear ______
20. Simple machine that has 3 classes
22. Simple machine cut in a spiral

*Duplication Permitted*

## TEACHER SUPPLEMENT #2

## CROSSWORD PUZZLE


1
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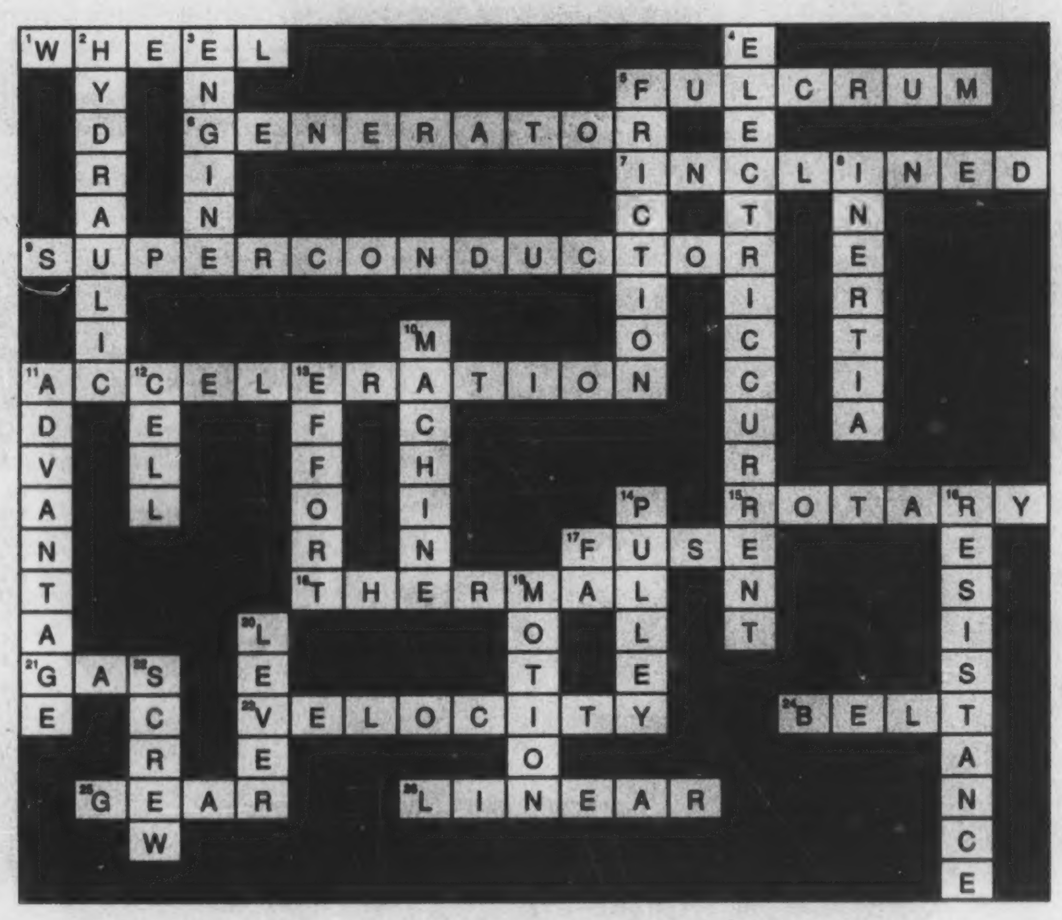
## TEACHER SUPPLEMENT #2

## CROSSWORD PUZZLE ANSWER KEY


1 WHEEL
2 HYDRAULIC
3 ENGINE
4 ELECTRIC CURRENT
5 FULCRUM
5 FRICTION
6 GENERATOR
7 INCLINED
8 INERTIA
9 SUPERCONDUCTOR
10 MACHINE
11 ACCELERATION
11 ADVANTAGE
12 CELL
13 EFFORT
14 PULLEY
15 ROTARY
16 RESISTANCE
17 FUSE
18 THERMAL
19 MOTION
20 LEVER
21 GAS
22 SCREW
23 VELOCITY
24 BELT
25 GEAR
26 LINEAR

# POWER TRANSMISSION, CONTROL AND STORAGE
## UNIT E-3

## TEACHER SUPPLEMENT #3—WORD SEARCH

Name ______________________________ Date ____________________

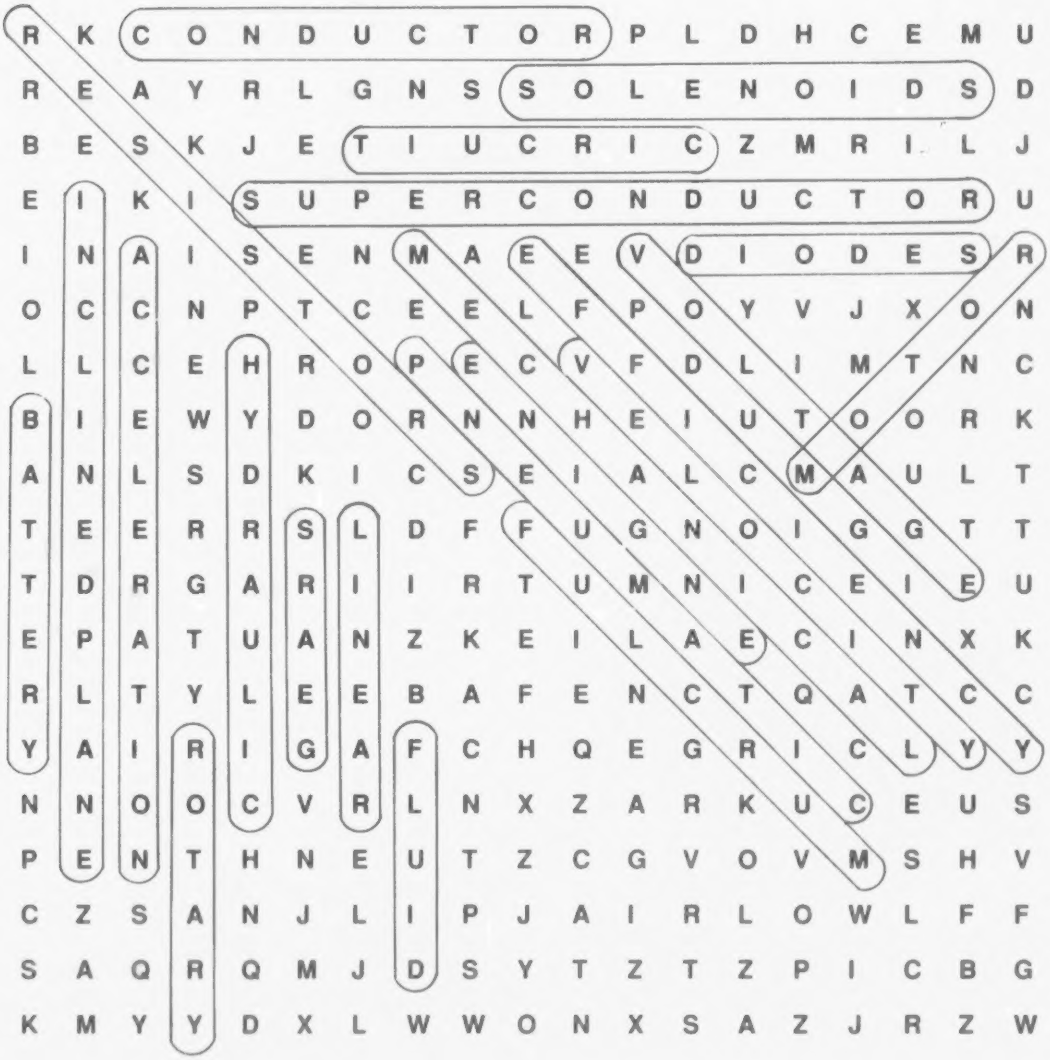
Directions: Find the words below hidden in the puzzle. Circle the words that you find.

SUPERCONDUCTOR
EFFICIENCY
RESISTORS
VOLTAGE
LINEAR
INCLINED PLANE
CONDUCTOR
SOLENOIDS
FULCRUM
GEARS
HYDRAULIC
VELOCITY
ENGINE
FLUID
ACCELERATION
PNEUMATIC
BATTERY
DIODES
MECHANICAL
CIRCUIT
ROTARY
MOTOR

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R | K | C | O | N | D | U | C | T | O | R | P | L | D | H | C | E | M | U |
| R | E | A | Y | R | L | G | N | S | S | O | L | E | N | O | I | D | S | D |
| B | E | S | K | J | E | T | I | U | C | R | I | C | Z | M | R | I | L | J |
| E | I | K | I | S | U | P | E | R | C | O | N | D | U | C | T | O | R | U |
| I | N | A | I | S | E | N | M | A | E | E | V | D | I | O | D | E | S | R |
| O | C | C | N | P | T | C | E | E | L | F | P | O | Y | V | J | X | O | N |
| L | L | C | E | H | R | O | P | E | C | V | F | D | L | I | M | T | N | C |
| B | I | E | W | Y | D | O | R | N | N | H | E | I | U | T | O | O | R | K |
| A | N | L | S | D | K | I | C | S | E | I | A | L | C | M | A | U | L | T |
| T | E | E | R | R | S | L | D | F | F | U | G | N | O | I | G | G | T | T |
| T | D | R | G | A | R | I | I | R | T | U | M | N | I | C | E | I | E | U |
| E | P | A | T | U | A | N | Z | K | E | I | L | A | E | C | I | N | X | K |
| R | L | T | Y | L | E | E | B | A | F | E | N | C | T | Q | A | T | C | C |
| Y | A | I | R | I | G | A | F | C | H | Q | E | G | R | I | C | L | Y | Y |
| N | N | O | O | C | V | R | L | N | X | Z | A | R | K | U | C | E | U | S |
| P | E | N | T | H | N | E | U | T | Z | C | G | V | O | V | M | S | H | V |
| C | Z | S | A | N | J | L | I | P | J | A | I | R | L | O | W | L | F | F |
| S | A | Q | R | Q | M | J | D | S | Y | T | Z | T | Z | P | I | C | B | G |
| K | M | Y | Y | D | X | L | W | W | O | N | X | S | A | Z | J | R | Z | W |

## TEACHER SUPPLEMENT #3

## WORD SEARCH ANSWER KEY

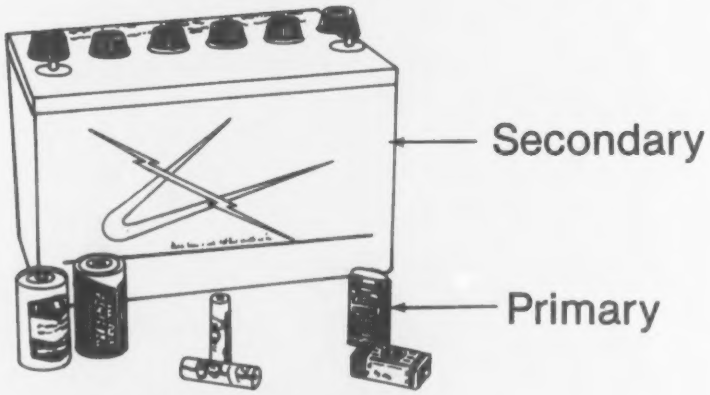


| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R | K | C | O | N | D | U | C | T | O | R | P | L | D | H | C | E | M | U |
| R | E | A | Y | R | L | G | N | S | S | O | L | E | N | O | I | D | S | D |
| B | E | S | K | J | E | T | I | U | C | R | I | C | Z | M | R | I | L | J |
| E | I | K | I | S | U | P | E | R | C | O | N | D | U | C | T | O | R | U |
| I | N | A | I | S | E | N | M | A | E | E | V | D | I | O | D | E | S | R |
| O | C | C | N | P | T | C | E | E | L | F | P | O | Y | V | J | X | O | N |
| L | L | C | E | H | R | O | P | E | C | V | F | D | L | I | M | T | N | C |
| B | I | E | W | Y | D | O | R | N | N | H | E | I | U | T | O | O | R | K |
| A | N | L | S | D | K | I | C | S | E | I | A | L | C | M | A | U | L | T |
| T | E | E | R | R | S | L | D | F | F | U | G | N | O | I | G | G | T | T |
| T | D | R | G | A | R | I | I | R | T | U | M | N | I | C | E | I | E | U |
| E | P | A | T | U | A | N | Z | K | E | I | L | A | E | C | I | N | X | K |
| R | L | T | Y | L | E | E | B | A | F | E | N | C | T | Q | A | T | C | C |
| Y | A | I | R | I | G | A | F | C | H | Q | E | G | R | I | C | L | Y | Y |
| N | N | O | O | C | V | R | L | N | X | Z | A | R | K | U | C | E | U | S |
| P | E | N | T | H | N | E | U | T | Z | C | G | V | O | V | M | S | H | V |
| C | Z | S | A | N | J | L | I | P | J | A | I | R | L | O | W | L | F | F |
| S | A | Q | R | Q | M | J | D | S | Y | T | Z | T | Z | P | I | C | B | G |
| K | M | Y | Y | D | X | L | W | W | O | N | X | S | A | Z | J | R | Z | W |

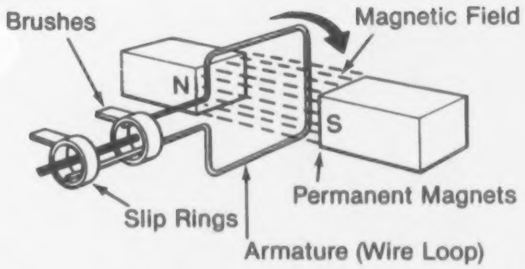
664

# Electrical Power Devices

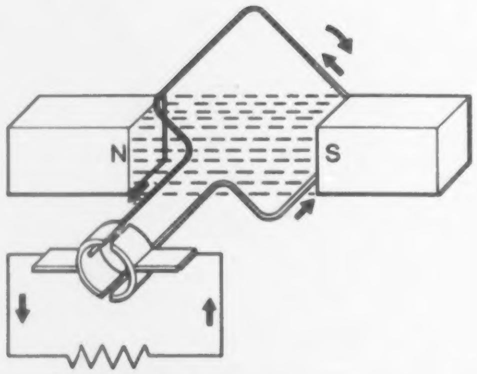
## (Input)


Secondary
Primary

**Battery Cells**


Brushes
Magnetic Field
N
S
Permanent Magnets
Slip Rings
Armature (Wire Loop)

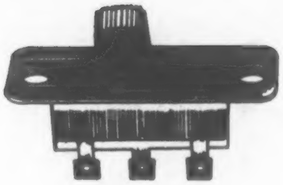
**Alternator**
(AC)



**Generator**
(DC)

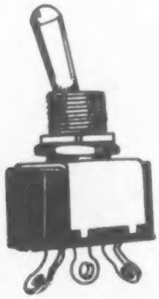
# Electrical Power Devices

## (Control)

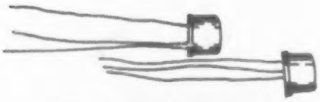


Slide Switch

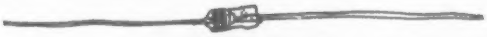
**Switches**



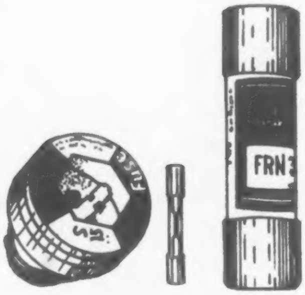
Toggle Switch



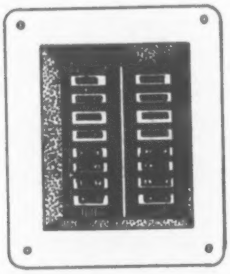
**Transistors**



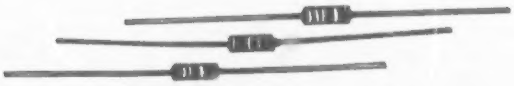
**Diode**



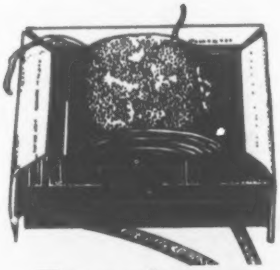
**Fuses**



**Circuit Breaker**



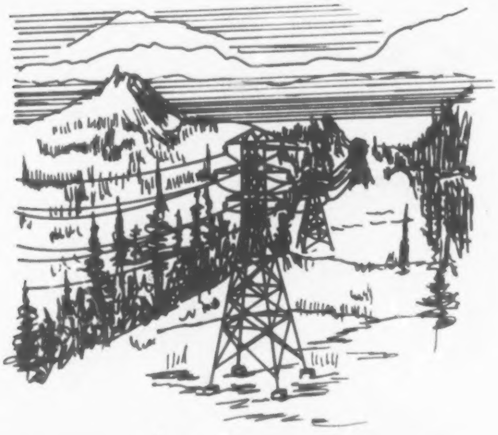
**Resistors**



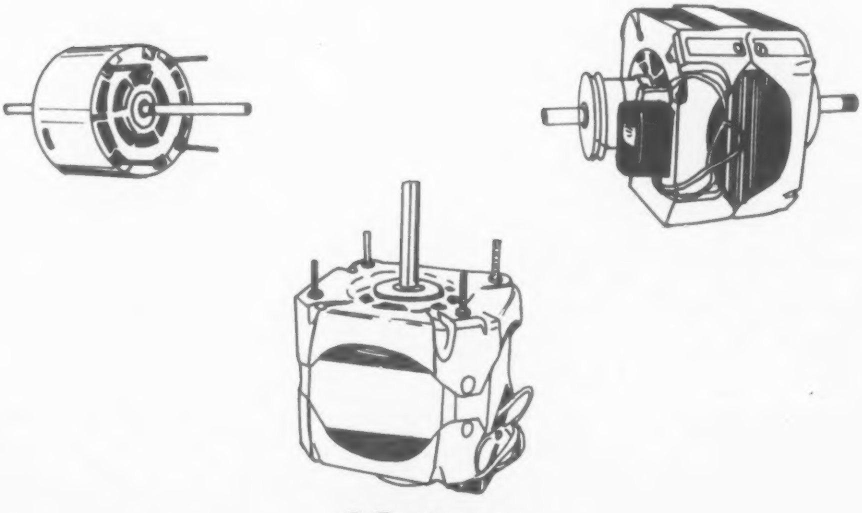
**Transformer**
(Iron Core)

# Electrical Power Devices

## (Transmission and Output)

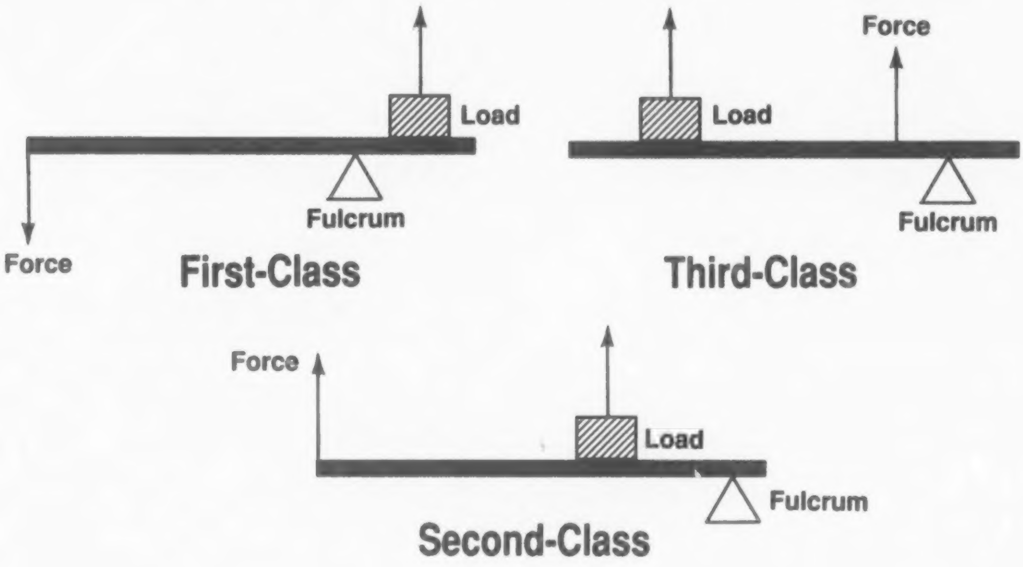


### Transmission Lines



### Motors

# Simple Machines
## (Mechanical Devices to Modify Force)

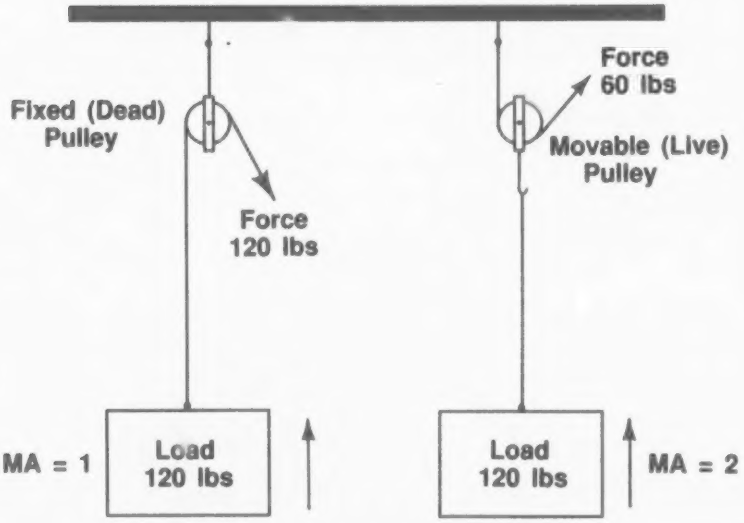

Load
Fulcrum
Force
Load
Force
Fulcrum
Force
Load
Fulcrum

First-Class

Third-Class

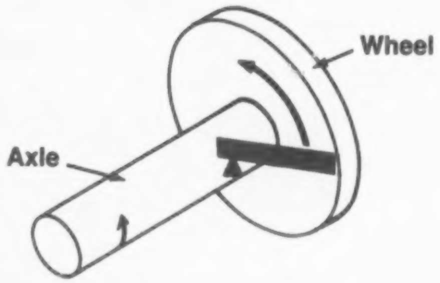
Second-Class

Levers

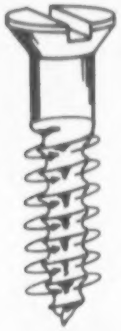

Fixed (Dead) Pulley
Force 120 lbs
Force 60 lbs
Movable (Live) Pulley
MA = 1
Load 120 lbs
Load 120 lbs
MA = 2

Pulleys

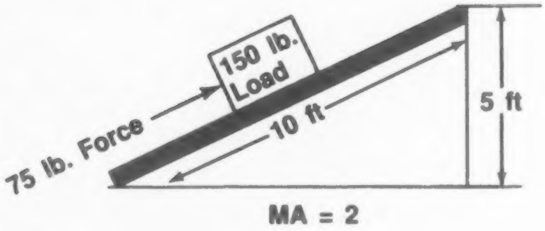
# Simple Machines
## (Continued)



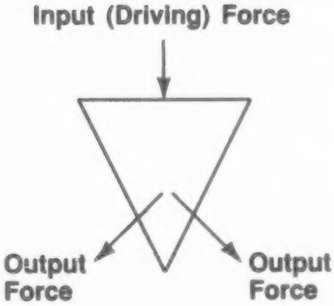
Wheel and Axle



Screw

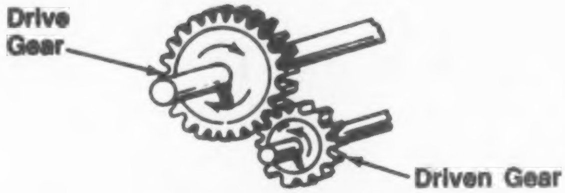

150 lb. Load
75 lb. Force
10 ft
5 ft
MA = 2

Inclined Plane

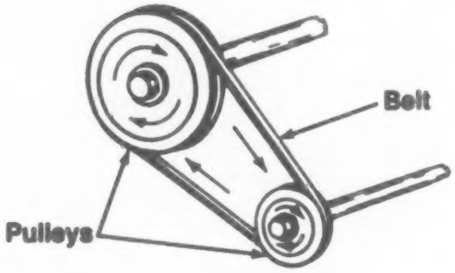

Input (Driving) Force
Output Force
Output Force

Wedge

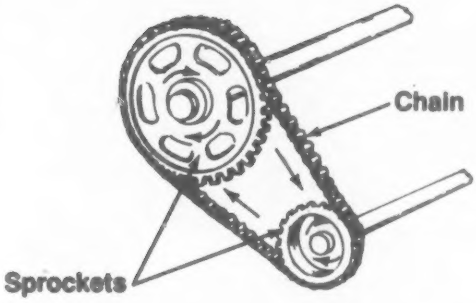
# Mechanical Drives


Drive Gear
Driven Gear

Gear Drive


Belt
Pulleys

Belt Drive


Chain
Sprockets

Chain Drive

# POWER TRANSMISSION, CONTROL, AND STORAGE
# UNIT E-3

## INFORMATION SHEET

I. **Terms and definitions**

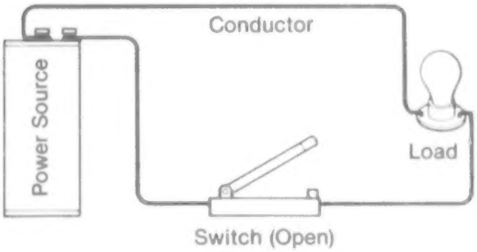
A. Acceleration — An increase in the speed of an object

B. Battery — Two or more cells connected together

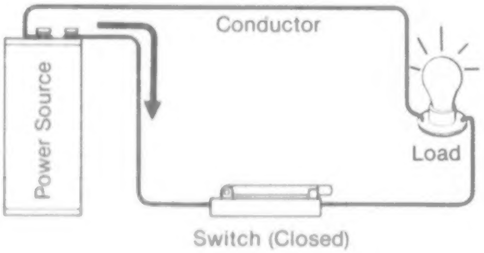
C. Cell — A container that holds electrodes and electrolytes for generating electricity by chemical action

D. Circuit — The complete path of an electric current

(NOTE: A circuit must have 4 parts — A source of power, a conductor, a switch, and a load. The following illustrations show these parts in an open circuit, and in a closed circuit. An open circuit is usually broken by an open switch or a disconnected wire. A closed circuit is required for current flow.)



**Simple Circuit (Open Circuit)**



**Simple Circuit (Closed Circuit)**

E. Conductor — A substance capable of transmitting electricity, heat, or sound

F. Deceleration — A decrease in the speed of an object

G. Efficiency — Ratio of the work output to the work input

$$E = \frac{\text{Work output}}{\text{Work input}} \times 100\%$$

H. Effort — Force applied **to** the machine

I. Electric current — The movement of electrons through a conductor

J. Engine — Device that converts any form of energy into mechanical energy

## INFORMATION SHEET

K. Fluid — Any liquid or gas

L. Friction — Resistance to motion between two surfaces in contact; re energy in the form of heat

(NOTE: Bearings and lubrication are used to reduce friction in mec devices.)

M. Fulcrum — The turning or pivot point of a lever

N. Inertia — The tendency of an object at rest to remain at rest, and of an in motion to continue in motion

O. Insulator — A substance that does not allow the transmission of ele heat, or sound

P. Machine — Device that changes the relationship between force and

Q. Mechanical advantage (MA) — The increase in force that you gain fro a machine

R. Momentum — The measured force of a moving body

(NOTE: The faster a body moves, or the greater its weight, the gre momentum.

S. Motor — An electrical- or fluid-operated device that produces rotary

T. Resistance — Force overcome **by** the machine

U. Superconductor — A substance capable of conducting a current resistance

V. Velocity — The speed of an object; distance per unit of time

W. Voltage — The electromotive force that causes electrons to move th circuit

II. **Types of power systems**

A. Fluid power — Moving liquid or gas with pressure

B. Electrical power — Moving electric current with voltage

C. Thermal power — Moving heat with temperature differences

D. Mechanical power — Moving objects, tools, and machines with force

## INFORMATION SHEET

III. **Types of fluid power systems**

A. Hydraulic systems — Use liquid under pressure to produce motion and perform work

Examples: Hydraulic lifts, landing gears, hydraulic robots

B. Pneumatic systems — Use air or gas under pressure to produce motion and perform work

Examples: Air compressors, pneumatic jack hammers, dentists' drills

IV. **Electrical power system devices**

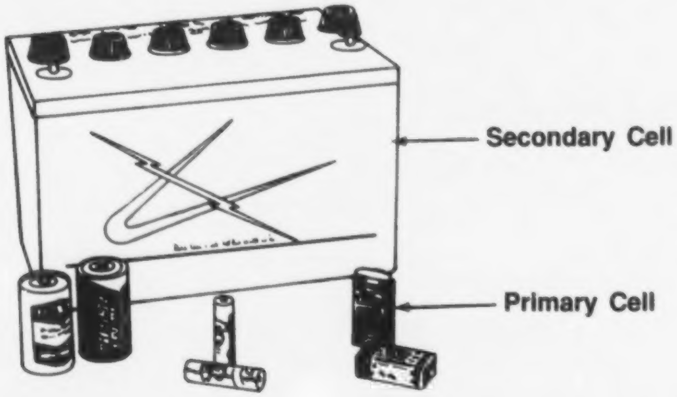
A. Devices for generation of electrical power (input)

1. Cells — Used to store energy and delivery it on demand

a. Primary cell — Produces power by direct chemical conversion. Once the chemical is used up, it cannot be recharged and is thrown away.

b. Secondary cell — Converts electricity into chemical energy, holds it until needed, and changes it back into electricity. Must be recharged by another power source after its chemical energy is used up.

(NOTE: Secondary cells are often grouped together to form storage batteries.)



2. Generators — Generate current that flows in only one direction (direct current - DC)

3. Alternators — Generate current that changes direction many times a second (alternating current - AC)

## INFORMATION SHEET

B. Devices for control of electrical power

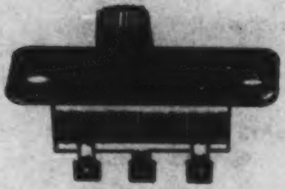
1. On-off control devices (switches)

   a. Manual switch — Most common electrical control device

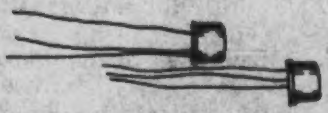
      Example: Common on-off light switch

   b. Relays — Allow the control of a circuit from a remote location

   c. Transistors — Control like relays except they have no moving parts; solid state



Switch



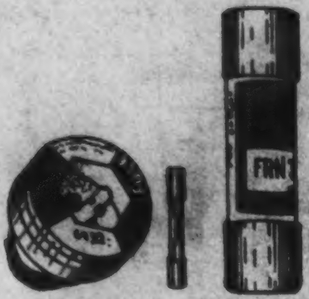
Transistors

2. Directional and overload control devices

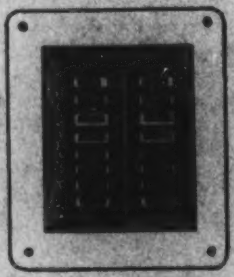
   a. Diodes — Permit current to flow in only one direction; solid state

   b. Fuses — Protect a circuit from dangerous overloads; must be replaced after use

   c. Circuit breakers — Have the same job as a fuse, but can be reset by hand after circuit is broken



Fuses



Circuit Breaker

## INFORMATION SHEET

3. Current and voltage control devices

    a. Transformers — Allow current to be stepped up or down

    b. Resistors — Reduce current flow and control voltage drop

C. Devices for transmission of electrical power — Current-carrying wires consisting of a conductor surrounded by an insulating material

(NOTE: Electricity is transmitted more efficiently than any other form of power.)

D. Devices for output of electrical power

1. Solenoids — Change electricity into linear motion

2. Motors — Change electricity into rotary motion

**V. Examples of thermal power systems**

A. Toasters and ovens

B. Irons and presses

C. Heaters and furnaces

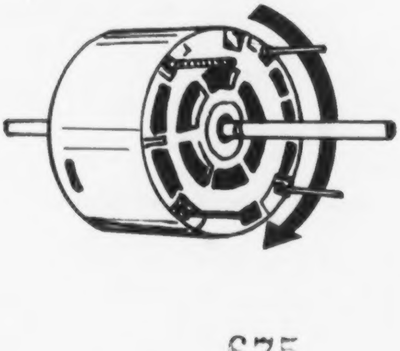
D. Dryers

(NOTE: Thermal power is also produced when resistance or friction is present in mechanical, electrical, or fluid power systems. However, this heat is unwanted and can cause damage. Cooling systems may be added to remove this unwanted thermal energy.)

**VI. Types of motion**

A. Rotary — Circular or turning motion

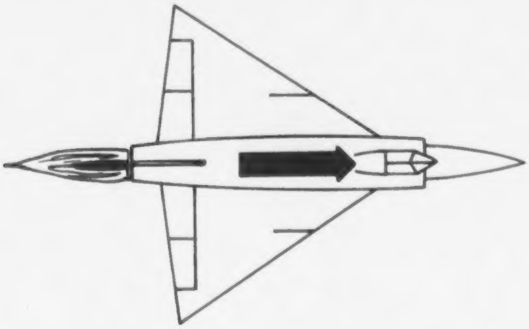
Examples: Fan, wheel, motor, turbine, windmill



## INFORMATION SHEET

B. Linear — Motion in a straight line

Example: Jet engine, bulldozer, conveyor belt, crane, elevator

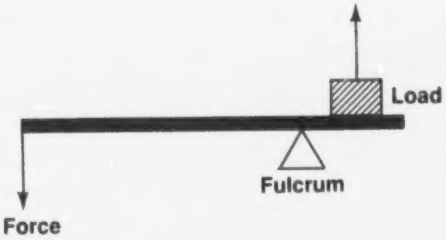


VII. **Types of simple machines for transmitting linear and rotational mechanical power**

A. Lever — A bar that rests on a pivot point (fulcrum) and some point along the bar.

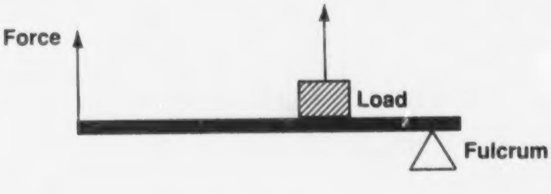
1. First-class lever

Examples: Teeter totter, pry bar



2. Second-class lever

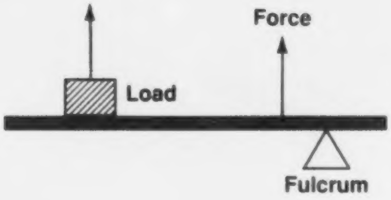
Example: Wheelbarrow



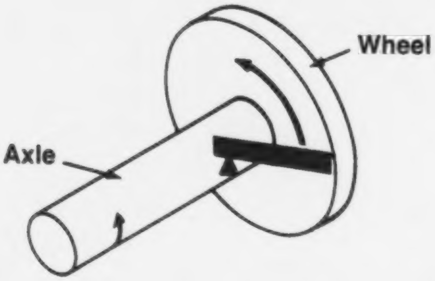
## INFORMATION SHEET

3. Third-class lever

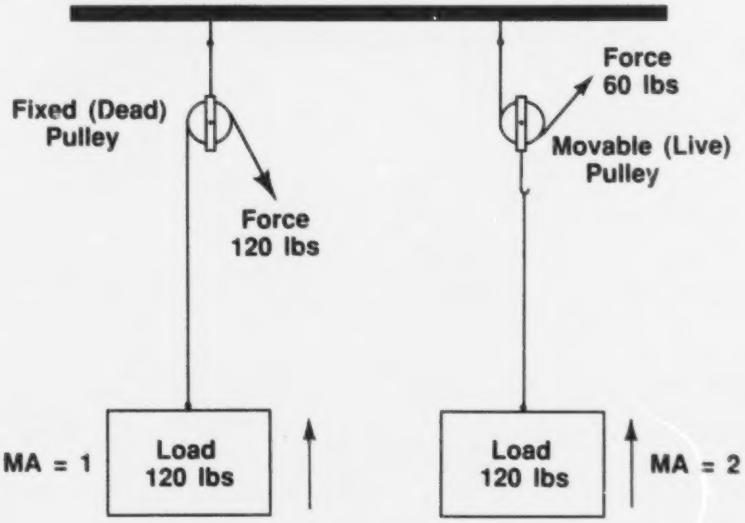
Example: Human arm


Force
Load
Fulcrum

B. Wheel and axle — Works on the same principle as a lever — radius of wheel acts as the lever, center of the axle is the fulcrum

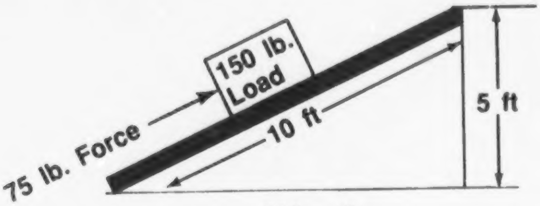


C. Pulley — Used to change direction of a pulling force or in various combinations to increase force for lifting weights (loads)


Force
60 lbs
Fixed (Dead)
Pulley
Movable (Live)
Pulley
Force
120 lbs
MA = 1
Load
120 lbs
Load
120 lbs
MA = 2

## INFORMATION SHEET

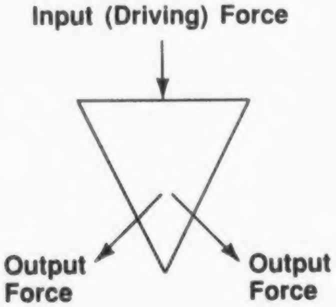
D. Inclined plane — Makes use of a sloping surface to increase force


150 lb.
Load
75 lb. Force
10 ft
5 ft

MA = 2

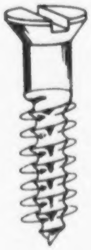
(NOTE: In the example shown, direct lifting of the load would have required 150 lbs. of force. Using the inclined plane at the grade shown [10/5], only a 75 lb. force is required.)

E. Wedge — Two inclined planes placed so that the sloping sides come together at a point


Input (Driving) Force
Output
Force
Output
Force

**Output force is greater than input (driving) force.**

F. Screw — An inclined plane cut in a spiral around a cone or shaft



(NOTE: All other machines are variations or combinations of these six simple machines.)

## INFORMATION SHEET

**VIII. Functions of machines — To modify mechanical power**

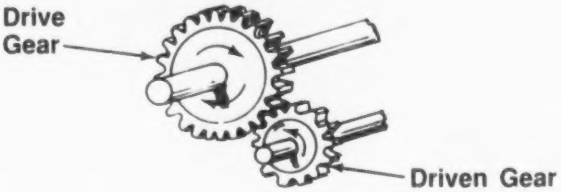
A. To increase force

B. To increase distance

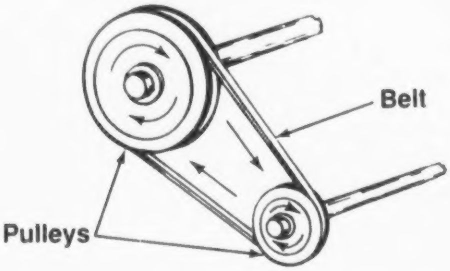
C. To change direction

**IX. Types of drives for transmitting and controlling rotational mechanical power**

A. Gear drive — Teeth in mating gears turn in opposite directions



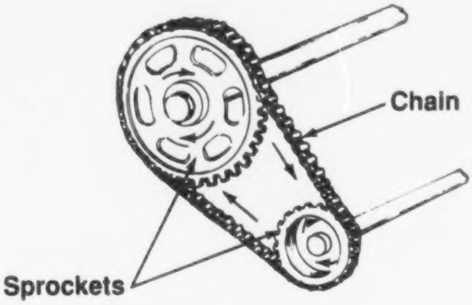
B. Belt drive — Rotation in one pulley is transmitted to other pulley through a flexible belt; both pulleys turn in same direction



## INFORMATION SHEET

C. Chain drive — Rotation in one sprocket is transmitted to other sprocket through a mesh chain; both sprockets turn in same direction

(NOTE: There is less slippage in the chain drive than in the belt drive.)



## X. Storing potential and kinetic energy

A. Storing potential energy — Chemical and nuclear energy

1. Can be stored for lengthy periods
2. Some may be liquified (natural gas) or pressurized (propane) to make them easier to be transported or stored.

B. Storing kinetic energy — Heat, mechanical, and electrical energy

1. May be stored momentarily or temporarily
2. Examples of momentary storage include electrical storage in capacitors and mechanical storage in a metal spring.
3. Examples of temporary storage include electrical storage in batteries, heat storage in a heat storage tank, and mechanical storage in a dam.

# POWER TRANSMISSION, CONTROL, AND STORAGE
## UNIT E-3

## ASSIGNMENT SHEET #1—DETERMINE MECHANICAL ADVANTAGE OF SIMPLE MACHINES

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Formulas are followed | ______ |
| Answers are correct | ______ |

Directions: Determine the mechanical advantages of the following simple machines. Use the appropriate formulas and show your work.

Work In = Work Out

$F_I \times D_I = F_o \times D_o$

$$\text{Ideal mechanical advantage (IMA)} = \frac{D_I}{D_o}$$

$$\text{Actual mechanical advantage (AMA)} = \frac{F_o}{F_I}$$

$F_I$ = Input force

$D_I$ = Distance moved by input force

$F_o$ = Output force (at load)

$D_o$ = Distance moved by output force

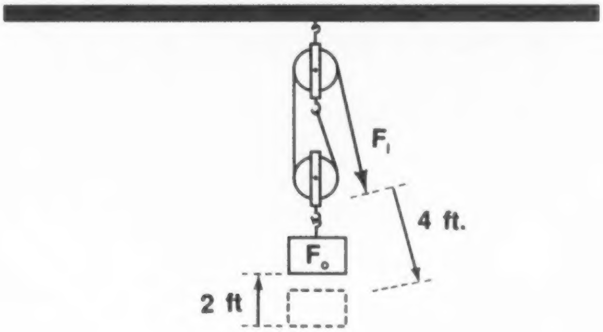
(NOTE: Ideal mechanical advantage equals actual mechanical advantage only where there is no friction or resistance — 100% efficiency.)

## ASSIGNMENT SHEET #1

Problems

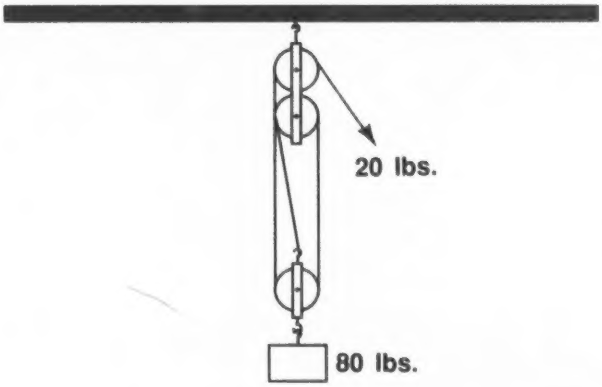
1. What is the ideal mechanical advantage for the following pulley system?

   IMA = ______________________________


$F_i$
4 ft.
$F_o$
2 ft

2. What is the actual mechanical advantage for the following pulley system?

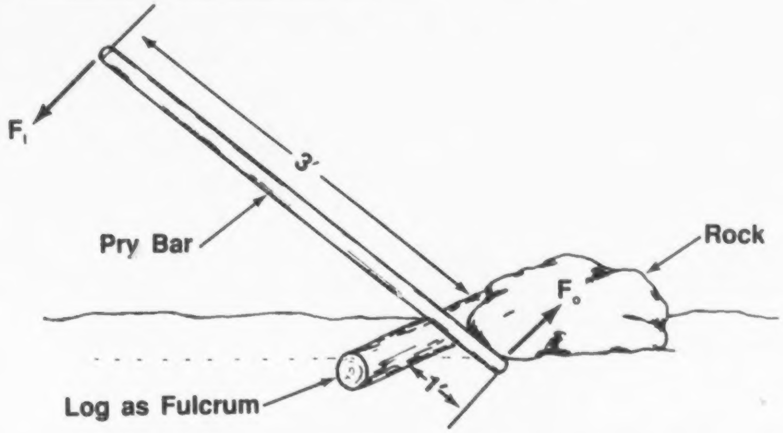
   AMA = ______________________________


20 lbs.
80 lbs.

## ASSIGNMENT SHEET #1

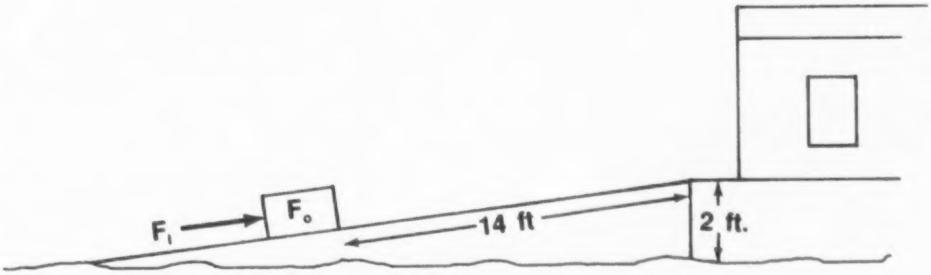
3. What is the ideal mechanical advantage of the following lever?

IMA = ____________________


$F_i$
3'
Pry Bar
Rock
$F_o$
Log as Fulcrum
1'

4. What is the ideal mechanical advantage of the following inclined plane?

IMA = ____________________


$F_i$
$F_o$
14 ft
2 ft.

## POWER TRANSMISSION, CONTROL, AND STORAGE
## UNIT E-3

## ASSIGNMENT SHEET #2—CALCULATE VELOCITY AND MILES PER HOUR

Name ______________________________ Overall Rating ______________

| EVALUATION CRITERIA | RATING |
|---|---|
| Formulas are followed | _____ |
| Answers are correct | _____ |

(NOTE: This activity will enable you to compute the miles per hour of the model racer that will be built later in this unit.)

Directions: Use the following formulas to solve the problems.

A. Formulas

$$\text{Velocity} = \frac{\text{distance}}{\text{time}} \text{ or } V = \frac{d}{t}$$

mph is the distance which an object would travel in one hour.

$$\text{mph} = \frac{V \text{ in ft/sec} \times 60 \text{ sec} \times 60 \text{ min}}{5280 \text{ ft}}$$

B. Problems

(NOTE: A calculator may be used. Round your answers to the nearest tenth.)

Given: "500" track length is 60 feet.

1. Compute the average velocity of a "Metric 500" car with a race time of .80 seconds.

V = ______________________

2. Compute the average mph of a "Metric 500" car with a race time of .80 seconds.

mph = ______________________

## ASSIGNMENT SHEET #2

3. Compute the average velocity of a "Metric 500" car with a race time of 1.00 second.

V = ____________________________

4. Compute the average mph of a "Metric 500" car with a race time of 1.00 second.

mph = ____________________________

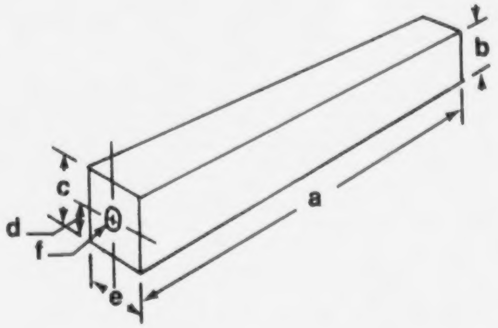
# POWER TRANSMISSION, CONTROL, AND STORAGE
## UNIT E-3

## ASSIGNMENT SHEET #3—DESIGN A MODEL RACER

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Design appearance and quality | ______ |
| Design meets specifications | ______ |
| Drawing quality/drafting technique | ______ |
| Neatness | ______ |

Directions: Design a model racer to be powered by a $CO_2$ cartridge according to the following specifications. Make a two-view (top and side) drawing with metric dimensions of your racer design.



Specifications for "Metric 500"

1. Dimensions for Body Blank
    - a. Length — 305 mm
    - b. Front height — 20 mm
    - c. Rear height — 70 mm
    - d. Bottom to centerline of power plant chamber — 31mm to 35 mm
    - e. Width — 42mm
    - f. Power plant chamber — 20 mm diameter, 51 mm depth, and drilled parallel to bottom surface. A minimum of 3 mm thickness around power plant housing must be maintained on all race cars for safety purposes.
    - g. The body of the model shall be one-piece, all-wood construction, and no parts (such as body strengtheners, fenders, plastic canopy, exhausts, or air foils) may be attached to or enclosed within the race cars. Bearings and lubricants may be used in construction.

2. Specific Tolerances

| | | Maximum | Minimum |
|---|---|---|---|
| a. | Axle diameter | 3mm | 3mm |
| b. | Axle length | 70mm | 42mm |
| c. | Axle bearing diameter | 4.5mm | 3.5mm |
| d. | Axle hole diameter | 4.5mm | 3.5mm |
| e. | Axle hole above body | 9mm | 3.5mm |

# POWER TRANSMISSION, CONTROL, AND STORAGE
## UNIT E-3

## ANSWERS TO ASSIGNMENT SHEETS

### Assignment Sheet #1

1. IMA = 2
2. AMA = 4
3. IMA = 3
4. IMA = 7

### Assignment Sheet #2

1. V = 75 ft/sec
2. 54.9 mph
3. V = 60 ft/sec
4. 40.9 mph

### Assignment Sheet #3

Evaluated according to the stated criteria

## POWER TRANSMISSION, CONTROL, AND STORAGE
## UNIT E-3

### LAB ACTIVITY SHEET #1—BUILD A MODEL RACER

Name ______________________________ Overall Rating ____________

| EVALUATION CRITERIA | RATING |
|---|---|
| Construction techniques | ______ |
| Finishing techniques | ______ |
| Test performance | ______ |
| Race performance | ______ |

A. Tools and materials

1. Wood block (1" × 2" × 12") or (42mm × 70mm × 300mm)
2. Templates and carbon paper
3. Pencil
4. Masking tape
5. Rubber bands
6. Half round cabinet file
7. Coarse, medium, and fine sandpaper
8. Pliers
9. Scratch awl
10. 3/16" twist drill
11. Half round wood rasp
12. C-clamps
13. Hand drill or drill press*
14. Scroll saw, coping saw, or bandsaw*
15. 3/4" spade bit
16. Screw eyes (2)
17. Soda straws
18. Washers (4)
19. Plastic wheels (2 front, 2 rear)
20. Axles (2 - 1/8" metal rod axles)

*(**CAUTION**: If power tools are used, have your teacher explain the proper and safe use before going any further. FOLLOW SAFETY PRECAUTIONS!)

(NOTE: Entire kit may be purchased from Pitsco, Inc., Box 1328, Pittsburg, KS 66762.)

## LAB ACTIVITY SHEET #1

B. Procedure

1. Using a grid sheet, draw a full scale model of your car design (top and side).

   (NOTE: Students should check drawings at this point for the following:

   ☐ Is the front axle in the correct position?

   ☐ Is rear axle in correct position?

   ☐ Is there sufficient room for $CO_2$ cartridge to fit in correct position?

   ☐ Does design fit within the height, width, and length dimensions allowed in Assignment Sheet #3?

2. Place drawing and carbon paper together and cut out drawing and carbon paper with scissors.

   (NOTE: These are templates or pattern pieces.)

3. Tape side-view template onto wooden block and trace around template with pencil; remove template.

4. Tape the top-view template to the bottom of the block and trace around template with pencil; remove template.

5. Mark axle locations.

6. Drill axle holes.

   (NOTE: Check limitations for correct position. Have instructor's approval before using any power equipment!)

7. Drill hole for $CO_2$ cartridge.

   (NOTE: Check limitations guides for exact placement.)

8. Cut the patterns using coping saw or bandsaw.

9. Shape the top view using wood rasp and file.

10. Smooth body by sanding.

    (NOTE: First use rough [60 grit] sandpaper, then medium sandpaper [100 grit].)

11. Cut and install soda straw bearings.

12. Place washers in position.

13. Force wheels on axles.

## LAB ACTIVITY SHEET #1

14. Check wheels for secure attachment and to see that axles turn freely.
15. Determine exact location of screw eyes.
16. Make holes using a scratch awl. Use pliers to insert and tighten screw eyes.
17. Look through screw eyes to check for interference.
18. Sand and smooth body (starting with 150 grit and finishing with 220 grit, after removing wheels, axles, and screw eyes.)
19. When car feels smooth, paint with a fast drying spray paint, at least two light coats.

    (NOTE: Car should be placed on a dowel rod, inserted in engine hole to allow free access.)
20. Check paint for flaws, and make repairs if needed.
21. Place decals and numerals in proper place.
22. Reinsert wheels, axles, and screw eyes.

    (NOTE: Check wheels for flaws. Use fine sandpaper to smooth any bumps or irregularities. Graphite may be rubbed along axle to allow faster turning.)
23. Test car.

## POWER TRANSMISSION, CONTROL, AND STORAGE
## UNIT E-3

### TEST

Name ________________________________ Score ____________________

1. Match the terms on the right with the correct definitions.

______a. Device that changes the relationship between force and speed

______b. The tendency of an object at rest to remain at rest, and of an object in motion to continue in motion

______c. Any liquid or gas

______d. Two or more cells connected together

______e. A decrease in the speed of an object

______f. The increase in force that you gain from using a machine

______g. Resistance to motion between two surfaces in contact; results in energy in the form of heat

______h. The speed of an object; distance per unit of time

______i. Force applied to the machine

______j. Force overcome by the machine

______k. The movement of electrons through a conductor

______l. An electrical- or fluid-operated device that produces rotary motion

______m. The complete path of an electric current

______n. A substance that does not allow the transmission of electricity, heat, or sound

______o. The turning or pivot point of a lever

1. Acceleration
2. Battery
3. Cell
4. Circuit
5. Conductor
6. Deceleration
7. Efficiency
8. Effort
9. Electric current
10. Engine
11. Fluid
12. Friction
13. Fulcrum
14. Inertia
15. Insulator
16. Machine
17. Mechanical advantage
18. Momentum
19. Motor
20. Resistance
21. Velocity

## TEST

2. Match the types of power systems on the right with the correct descriptions.

______a. Moving liquid or gas with pressure

______b. Moving electric current with voltage

______c. Moving heat with temperature differences

______d. Moving objects, tools, and machines with force or torque

1. Electrical
2. Fluid
3. Mechanical
4. Thermal

3. Distinguish between types of fluid power systems by placing an "X" next to the description of pneumatic systems.

______a. Use air or gas under pressure to produce motion and perform work

______b. Use liquid under pressure to produce motion and perform work

4. Complete the following statements concerning electrical power system devices by circling the correct words.

   a. A (primary cell, secondary cell) converts electricity into chemical energy, holds it until needed, and changes it back into electricity. Must be recharged by another power source after its chemical energy is used up.

   b. Alternators generate (direct, alternating) current.

   c. (Transformers, Resistors) allow current to be stepped up or down.

   d. Solenoids change electricity into (rotary, linear) motion.

   e. The most common electrical control device is the (switch, diode).

5. List three examples of thermal power systems.

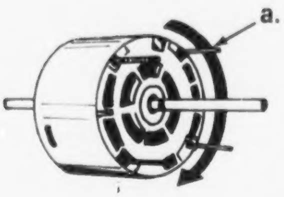
   a. ______________________________________________

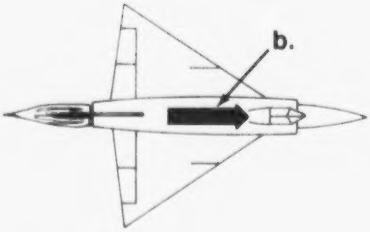
   b. ______________________________________________

   c. ______________________________________________

## TEST

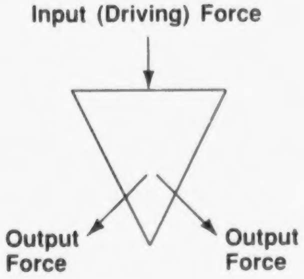
6. Identify the following types of motion.

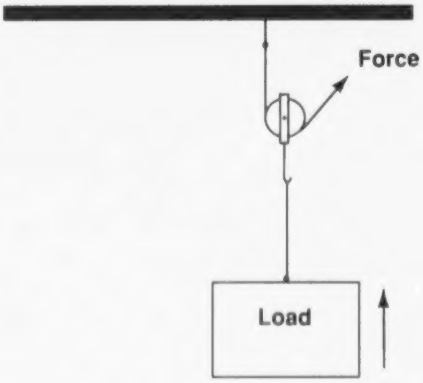




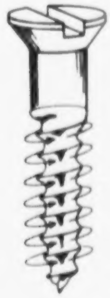
a. ______________________ b. ______________________

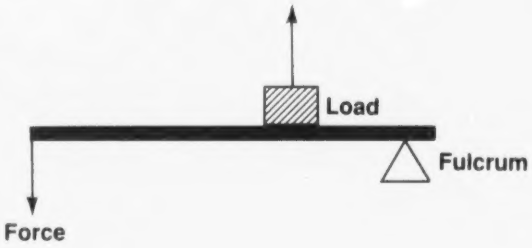
7. Identify the following types of simple machines for transmitting mechanical power.


Input (Driving) Force
Output Force
Output Force



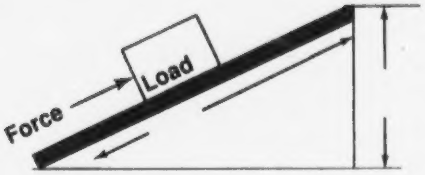
a. ______________________ b. ______________________

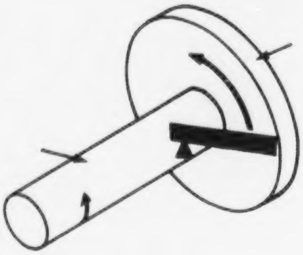



Load
Fulcrum
Force

c. ______________________ d. ______________________

## TEST





e. ____________________ f. ____________________

8. Select from the following list the correct functions of machines by placing an "X" in the appropriate blanks.

_____a. To increase momentum

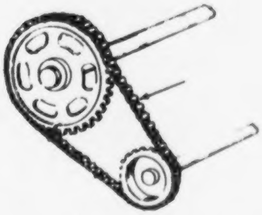
_____b. To increase force

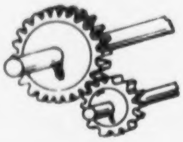
_____c. To increase distance

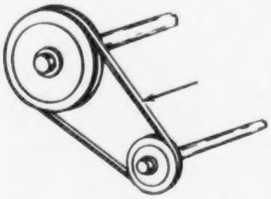
_____d. To change direction

_____e. To decrease force

9. Identify the following types of drives for transmitting and controlling mechanical power.







a. ____________________ b. ____________________ c. ____________________

## TEST

10. Complete the following statements concerning storing potential and kinetic energy by circling the correct words.

    a. (Potential, Kinetic) energy can be stored for lengthy periods.

    b. Heat, mechanical, and electrical energy are forms of (kinetic, potential) energy.

    c. An example of momentary storage includes (mechanical, electrical) storage in capacitors.

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

11. Determine mechanical advantage of simple machines. (Assignment Sheet #1)

12. Calculate velocity and miles per hour. (Assignment Sheet #2)

13. Design a model racer. (Assignment Sheet #3)

14. Build a model racer. (Lab Activity Sheet #1)

## POWER TRANSMISSION, CONTROL, AND STORAGE
## UNIT E-3

### ANSWERS TO TEST

1. a. 16
   b. 14
   c. 11
   d. 2
   e. 6
   f. 17
   g. 12
   h. 21
   i. 8
   j. 20
   k. 9
   l. 19
   m. 4
   n. 15
   o. 13

2. a. 2
   b. 1
   c. 4
   d. 3

3. a

4. a. Secondary cell
   b. Alternating
   c. Transformers
   d. Linear
   e. Switch

5. Any three of the following:

   a. Toasters, ovens
   b. Irons, presses
   c. Heaters, furnaces
   d. Dryers

6. a. Rotary
   b. Linear

7. a. Wedge
   b. Pulley
   c. Screw
   d. Lever
   e. Inclined plane
   f. Wheel and axle

8. b, c, d

## ANSWERS TO TEST

9. a. Chain drive
   b. Gear drive
   c. Belt drive

10. a. Potential
    b. Kinetic
    c. Electrical

11.-14. Evaluated to the satisfaction of the instructor

# TRANSPORTATION SYSTEMS
# UNIT E-4

## UNIT OBJECTIVE

After completion of this unit, the student should be able to complete statements concerning the basic modes of transportation. Competencies will be demonstrated by completing the assignment sheets and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to transportation systems with the correct definitions.
2. Select from a list the purposes of transportation.
3. Match the components of a transportation system with the correct uses.
4. List the basic modes of transportation.
5. Complete statements concerning highway transportation.
6. Complete statements concerning railway transportation.
7. Select true statements concerning pipeline transportation.
8. Distinguish between types of on-site transportation.
9. Complete statements concerning water transportation.
10. Select true statements concerning air transportation.
11. Select true statements concerning space transportation.
12. Solve gas mileage problems. (Assignment Sheet #1)
13. Classify cargo and services transported to your community. (Assignment Sheet #2)
14. Design and build a model transportation vehicle or system. (Assignment Sheet #3)

## TRANSPORTATION SYSTEMS
## UNIT E-4

### SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit. These appear in the teacher edition only and are designed to be used with the following objectives:

TM 1 — Purposes of Transportation — Objective 2

TM 2 — Basic Modes of Transportation — Objective 4

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. Use Teacher Supplement #1 to present AIT video E-4. This video was developed by the Agency for Instructional Technology (AIT) and a consortium of states to accompany this publication. Contact your state supervisor of technology education for copies, or contact AIT directly for more information:

   Agency for Instructional Technology (AIT)
   Box A, Bloomington, IN 47402
   800-457-4509 or 812-339-2203

2. Use Teacher Supplements #2 and #3 to help students understand this unit's terminology. Make copies (fronts only) for your students. The answers are on the backs of the supplements.

3. Show films on transportation. Possible films are listed on the following pages.

4. Discuss the advantages and disadvantages of each mode of transportation. Discuss how you would select one mode over the others. Consider economics, speed, and environmental factors.

5. Use the computer and appropriate software to simulate transportation. Suggested resources are listed on the following pages.

## SUGGESTED ACTIVITIES

6. Provide materials for students to build transportation vehicles or systems. (Assignment Sheet #3) Kits may be used if there is not enough time for a complete design process.

7. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Give test.

I. Evaluate test.

J. Reteach if necessary.

## REFERENCES FOR DEVELOPING THIS UNIT

A. Alexander, William, et. al. *Transportation: The Technology of Moving People*. Worcester, MA: Davis Publications, Inc., 1986.

B. Barden, Robert and Michael Hacker. *Living with Technology*. Albany, NY: Delmar Publishers, Inc., 1988.

C. Bohn, Ralph C., et. al. *Energy, Power, and Transportation Technology*. Peoria, IL: Bennett & McKnight, 1986.

D. Cummings, Paul and E. Allen Bame. *Exploring Technology*. Worcester, MA: Davis Publications, Inc., 1988.

E. Linbeck, John R. and Irvin T. Lathrop. *General Industry and Technology*. Encino, CA: Glencoe Publishing Company, 1986.

F. Smith, Howard Bud, ed. *Exploring Energy: Sources/Applications/Alternatives*. South Holland, IL: Goodheart-Willcox Co., Inc., 1985.

G. Walker, John R. *Exploring Power Technology: Basic Fundamentals*. South Holland, IL: Goodheart-Willcox Co., Inc., 1981.

## SUGGESTED SUPPLEMENTAL RESOURCES

A. Films and videotapes

1. *Working in Transportation*, 1982; 11151 (21 min.)

Bureau of Audio Visual Instruction
P.O. Box 2093
Madison, WI 53701-2093

## SUGGESTED ACTIVITIES

2. *The Transportation Revolution: Story of America's Growth;* 03547 (19 min., color)

   OSU AudioVisual Center
   Stillwater, Oklahoma 74074
   (405) 624-7216

3. *American Transportation: Horseback to Jet* (266)

   Life Filmstrips
   Time-Life Building
   Rockefeller Center
   New York, NY 10020

4. *Transportation Systems,* 13 min.

   Agency for Instructional Technology
   Box A
   Bloomington, IN 47402
   800-457-4509

5. *Automobile...Its First 100 Years; Highways of History; Model Railroading Unlimited; Motor Oil: What's the Difference.*

   Modern Talking Picture Service
   5000 Park Street North
   St. Petersburg, FL 33709

6. *To Fly; Touch the Sky.*

   Air & Space Smithsonian
   P.O. Box 51244
   Boulder, CO 80321-1244

7. *Thunderbirds; The F111—Beyond the Challenge; F-16C—Better than the Best.*

   General Dynamics
   Audiovisual Library
   Dept. 17-2; Mail Zone 6624
   P.O. Box 748
   Forth Worth, TX 76101

8. *America's Achievements in Space; In the Cockpit; Men Walk on the Moon.*

   Easton Press
   47 Richards Ave.
   P.O. Box 5706
   Norwalk, Conn 06856-9927

## SUGGESTED ACTIVITIES

B. Pamphlets and Charts

1. *List of FAA Aviation Education Material*

   Department of Transportation
   Federal Aviation Administration
   Washington, DC 20591

2. *Who in the World Needs Railroads?*

   Public Relations Department
   Atchison, Topeka, and Santa Fe Railway
   80 East Jackson Boulevard
   Chicago, IL 60604

3. *Plane Folder* (pictures of planes)

   Delta Airlines, Inc.
   Public Relations Department
   Hartsfield-Atlanta International Airport
   Atlanta, GA 30320

4. *Big Load Afloat*

   The American Waterways Operators, Inc.
   1600 Wilson Boulevard
   Suite 1101
   Arlington, VA 22209

5. *America Runs on Wheels*

   Motor Vehicle Manufacturer's Association of the U.S., Inc.
   300 New Center Building
   Detroit, Michigan 48202

6. *Energy and Transportation*

   U.S. Department of Energy
   Technical Information Center
   P.O. Box 62
   Oak Ridge, TN 37830

C. Computer Software

1. Estes Rocketry Software — *AstroCAD; Aerotrek; Flight; Physics; In Search of Space; Car Builder; GlidePath.*

   Hearlihy Co., Inc.
   714 W. Columbia Street
   Springfield, OH 45501
   800-622-1000

## SUGGESTED ACTIVITIES

2. The following software is available from local computer software dealers and mail order firms such as:

CompuAdd (IBM Software)
12303 Technology Boulevard
Austin, TX 78727
800-627-1967

Lyco Computer (IBM and Apple Software)
P.O. Box 5088
Jersey Shore, PA 17740
800-233-8760

- *Microsoft Flight Simulator — Gates Lear Jet; Cessna 1982*
- *Chuck Yeager Flight Simulator — 18 types*
- *F15 Strike Eagle*
- *F19 Stealth Fighter*
- *Orbiter — Shuttle Simulator*
- *Space Station — M.A.X.*
- *Test Drive*
- *Helicopter Simulator*
- *Submarine Simulator*

3. The following public domain software is available for IBM computers from:

Public Brand Software
P.O. Box 51315
Indianapolis, IN 46251

- *Ford Driving Simulator I & II*
- *Engine (Piston)*
- *Race Manager*
- *Air Traffic Control Simulator*
- *Electronic Circuit Calculator*
- *Glider Statistics*
- *Rocket Analysis*
- *Astronautical Engineering*
- *747 Flight Simulator*
- *Rocket Simulator*

D. Magazine resources

1. *Air and Space Magazine*

National Air & Space Museum Smithsonian Institute
P.O. Box 51244
Boulder, CO 80321-1244

2. *Aviation Week and Space Technology*

P.O. Box 503
Hightstown, NJ 08520-9899

## SUGGESTED ACTIVITIES

3. *Ad Astra*

National Space Society
P.O. Box 96651
Washington, DC 20077-7475

4. *Popular Mechanics*

P.O. Box 10060
Des Moines, IA 50347-0060

5. *Popular Science*

P.O. Box 51824
Boulder, CO 80321-1824

6. *The Planetary Report*

The Planetary Society
65 N Catalina Ave.
Pasadena, CA 91106

7. *Astronomy*

1027 North Seventh Street
Milwaukee, WI 53233-9968

8. *OMNI*

P.O. Box 3026
Harland, IA 51593-2087

9. *Final Frontier*

P.O. Box 3803
Escondido, CA 92025-9561

E. Corporation Resources

The following corporations have resources (posters, pictures, information sheets, etc.) available for educational use.

1. McDonnell Douglas Corporation
Box 516
St. Louis, MO 63166

2. American Airlines
Flight Academy
P.O. Box 619617
DFW Airport, TX 75261-9617

## SUGGESTED ACTIVITIES

3. General Motors Corporation
   General Motors Technical Center
   Warren, MI 48090

4. Boeing Commercial Airplane Co.
   MS 65-47
   P.O. Box 3707
   Seattle, WA 98124

5. Northrop Corp.
   1800 Century Park E.
   Los Angeles, CA 90067

6. Lockheed Corp.
   2555 N. Hollywood Way
   Burbank, CA 91520

7. Rockwell Intl. Corp.
   600 Grand St.
   Pittsburgh, PA 91520

8. Cessna Aircraft Company
   P.O. Box 1521
   Wichita, KS 67201

9. U.S. Department of Transportation
   Federal Aviation Administration
   Washington, D.C. 20591

10. Ford Motor Co.
    21175 Oakwood Boulevard
    Dearborn, MI 48123

11. National Air & Space Museum
    Smithsonian Institution
    P.O. Box 51244
    Boulder, CO 80321-1244

F. Material Resources

1. Electric motors can be purchased from:

   Edmund Scientific Co.
   101 E. Gloucester Pike
   Barrington, NJ 08007-1380
   609-573-6250

## SUGGESTED ACTIVITIES

2. Model rocket supplies can be purchased from:

   Estes Industries
   P.O. Box 227
   1295 H Street
   Penrose, CO 81240

# TRANSPORTATION SYSTEMS
# UNIT E-4

## TEACHER SUPPLEMENT #1—USING AIT VIDEO E-4

### Introduction and Program Summary (12:48)

This program presents different kinds of transportation systems and discusses the history and growth of transportation technology.

Defining transportation as the movement of people and things, the program points out that transportation systems can be analyzed in terms of the systems model. Transportation systems use land, water, air, and space.

The program reviews technological progress in transportation through history. The earliest systems used human and animal power; the railroad brought mass transportation; and cars made travel private and personal. Today automotive manufacturing is the largest industry in the world and Japan's bullet train travels at up to 200 miles per hour. On water, transportation has progressed from primitive canoes to today's large cargo ships. Air travel began with balloons and attempts to build man-powered aircraft. The Wright brothers' successful flying machine led to the "shrinking of the world" and to the exploration of space.

The program visits the headquarters of Federal Express and profiles a courier. Such large intermodal transportation networks involve a variety of transportation systems working together. The transportation of the future will undoubtedly bring greater distance and speed with less expenditure of energy. Electric or solar cars, trains moving by magnetic levitation, a space plane, and an orbiting space station are all possibilities. In the meantime, we have to confront the problem of our decaying infrastructure, our roads and bridges.

### Video Program Objectives

The video program will illustrate that

- transportation is used to conquer time and space
- efficient transportation systems are often intermodal, involving several different kinds of transportation
- transportation technologies continue to advance while the infrastructure of roads, bridges, highways, airports, and railways are deteriorating

### Before the Program

1. Tell your students this lesson introduces transportation systems and their importance to us. Ask them how technology helps people conquer time and space. Show models or pictures of the space shuttle, jets, supertankers, trains, or other modern vehicles, and ask students how each has affected us. What if these vehicles had never been invented or developed? What do they have in common?

## TEACHER SUPPLEMENT #1

2. Ask students to name the safest kind of public transportation. List their responses and tell them that this question will be answered in the video program.

3. Tell students what they will be doing in the lab, and how the content of the video program will set the stage for the laboratory activity.

4. Tell students to note the following in the video program: personal and mass transit transportation vehicles; people who have advanced transportation technology and what they have done; the universal systems model as it applies to transportation; the effect of developments in transportation technology on people; the way different kinds of transportation work together.

5. Tell students that the following terms and career will be mentioned in the video program. (You might write them on the chalkboard.)

**Terms**

transportation
escalators
aircraft carriers
subsystems
maglev train
public transportation
belt conveyors
submarines
"tracker"
infrastructure
elevators
pipeline
cargo plane
intermodal
space station

**Career**

courier of express mail company

**After the Program: Questions for Discussion and Review**

1. What is transportation? *(the movement of people and things)*

2. What are some examples of transportation and the problems it addresses? *(moving people from one floor to another; moving people and goods from one city to another; transporting liquids through a pipeline; transporting bank information from a distant drive-in location)*

3. Where does transportation occur? *(land, water, air, and space)*

4. Historically, what are some of the major technological developments in transportation that are described in the video program? *(the wheel, steam engine, trains and railroads, automobile, airplane)* Can students think of others?

5. Describe Federal Express's subsystems of intermodal transportation. *(Federal Express makes use of planes, trucks, vans, conveyor belts, small tractors, and elevator systems, and monitors them with a "tracker.")* What is the advantage of intermodal transportation? *(Optimum use of each system involved ensures goods are moved faster and more efficiently than ever before.)*

## TEACHER SUPPLEMENT #1

6. What will transportation be like in the future? *(We will travel faster and farther using less energy. There may be magnetic levitation trains, space planes, solar cars, and space shuttles traveling to orbiting space stations.)*
7. What are current problems in transportation and how can we solve them? *(Infrastructure is deteriorating; airports and roads are overcrowded; gasoline engines cause pollution.)* Discuss solutions to these problems.
8. What is the safest public transportation system? *(the elevator)*

# TRANSPORTATION SYSTEMS
# UNIT E-4

## TEACHER SUPPLEMENT #2—CROSSWORD PUZZLE

Name ________________________________ Date ____________________

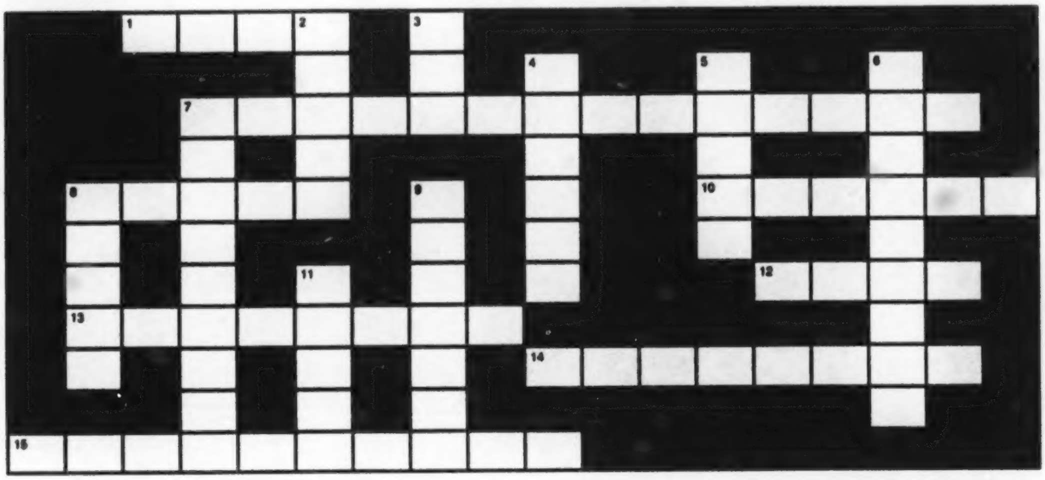
Directions: Use the clues below to solve the puzzle.

ACROSS

1. Large water vessel for cruises
7. Movement of people and material
8. Flat water vessel for cargo
10. Heavier-than-air craft with no engine
12. Guideway for a train
13. Rail above ground
14. Moves oil, water, gas
15. People being transported

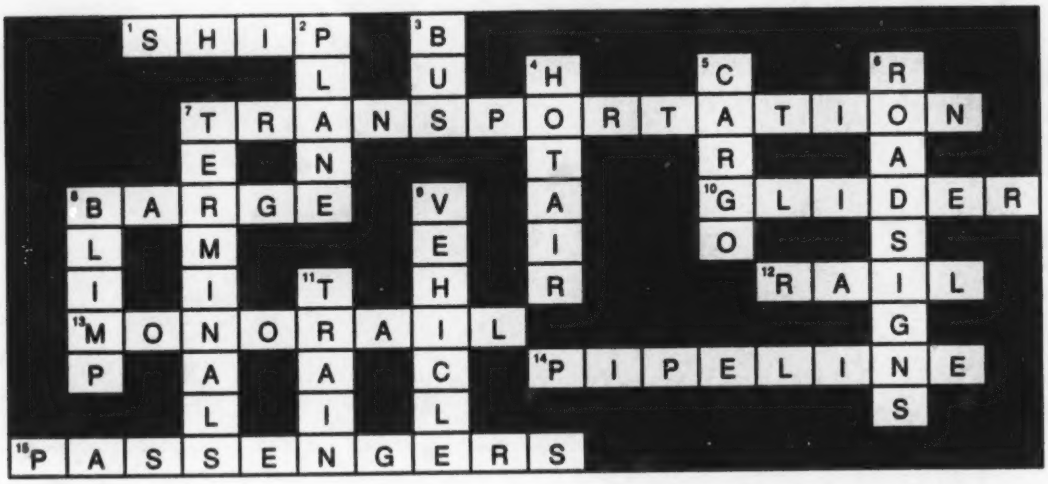
DOWN

2. Heavier-than-air craft with engine
3. Commercial passenger land vehicle
4. Balloon for transportation
5. Solid, liquid, or gaseous material being moved
6. Communication method to highway drivers
7. Beginning and ending points for passengers and cargo
8. Lighter-than-air craft
9. Carries the cargo or passengers
11. Rides on a rail



## TEACHER SUPPLEMENT #2

## CROSSWORD PUZZLE ANSWER KEY


1 SHIP
2 PLANE
3 BUS
4 HOTAIR
5 CARGO
6 ROADSIGNS
7 TRANSPORTATION
TERMINAL
8 BARGE
BLIMP
9 VEHICLE
10 GLIDER
11 TRAIL
12 RAIL
13 MONORAIL
14 PIPELINE
15 PASSENGERS

## TRANSPORTATION SYSTEMS
## UNIT E-4

### TEACHER SUPPLEMENT #3—WORD SEARCH

Name ______________________________ Date ________________

Directions: Find the words below hidden in the puzzle. Circle the words that you find.

TRANSPORTATION
PASSENGERS
VEHICLES
CONTROL SYSTEM
SPACE

AIRPLANE
ROCKET
MODE
ESCALATORS
CONVEYOR

LAND
COMMERCIAL
PIPELINE
CARGO
SHIP

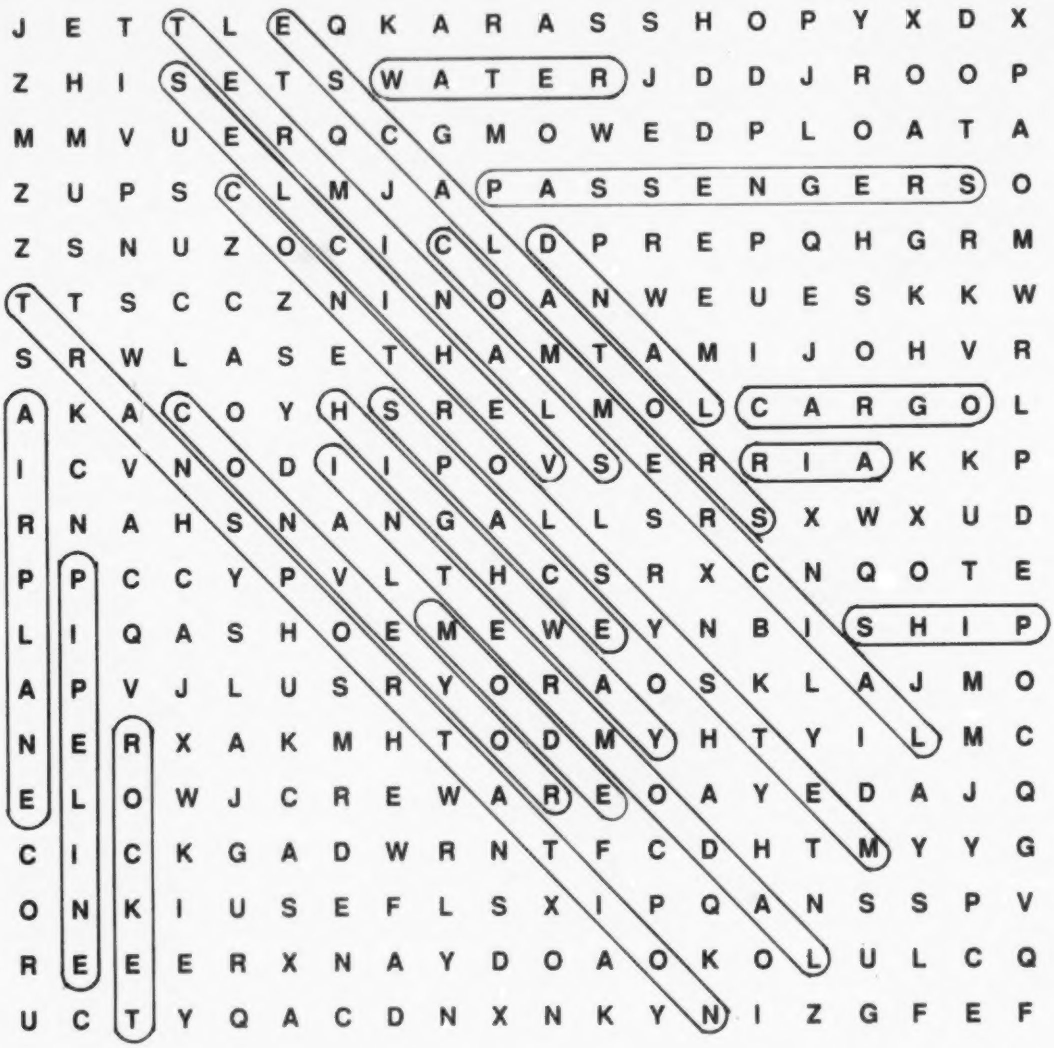
INTERMODAL
TERMINALS
HIGHWAY
WATER
AIR

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| J | E | T | T | L | E | Q | K | A | R | A | S | S | H | O | P | Y | X | D | X |
| Z | H | I | S | E | T | S | W | A | T | E | R | J | D | D | J | R | O | O | P |
| M | M | V | U | E | R | Q | C | G | M | O | W | E | D | P | L | O | A | T | A |
| Z | U | P | S | C | L | M | J | A | P | A | S | S | E | N | G | E | R | S | O |
| Z | S | N | U | Z | O | C | I | C | L | D | P | R | E | P | Q | H | G | R | M |
| T | T | S | C | C | Z | N | I | N | O | A | N | W | E | U | E | S | K | K | W |
| S | R | W | L | A | S | E | T | H | A | M | T | A | M | I | J | O | H | V | R |
| A | K | A | C | O | Y | H | S | R | E | L | M | O | L | C | A | R | G | O | L |
| I | C | V | N | O | D | I | I | P | O | V | S | E | R | R | I | A | K | K | P |
| R | N | A | H | S | N | A | N | G | A | L | L | S | R | S | X | W | X | U | D |
| P | P | C | C | Y | P | V | L | T | H | C | S | R | X | C | N | Q | O | T | E |
| L | I | Q | A | S | H | O | E | M | E | W | E | Y | N | B | I | S | H | I | P |
| A | P | V | J | L | U | S | R | Y | O | R | A | O | S | K | L | A | J | M | O |
| N | E | R | X | A | K | M | H | T | O | D | M | Y | H | T | Y | I | L | M | C |
| E | L | O | W | J | C | R | E | W | A | R | E | O | A | Y | E | D | A | J | Q |
| C | I | C | K | G | A | D | W | R | N | T | F | C | D | H | T | M | Y | Y | G |
| O | N | K | I | U | S | E | F | L | S | X | I | P | Q | A | N | S | S | P | V |
| R | E | E | E | R | X | N | A | Y | D | O | A | O | K | O | L | U | L | C | Q |
| U | C | T | Y | Q | A | C | D | N | X | N | K | Y | N | I | Z | G | F | E | F |

*Duplication Permitted*

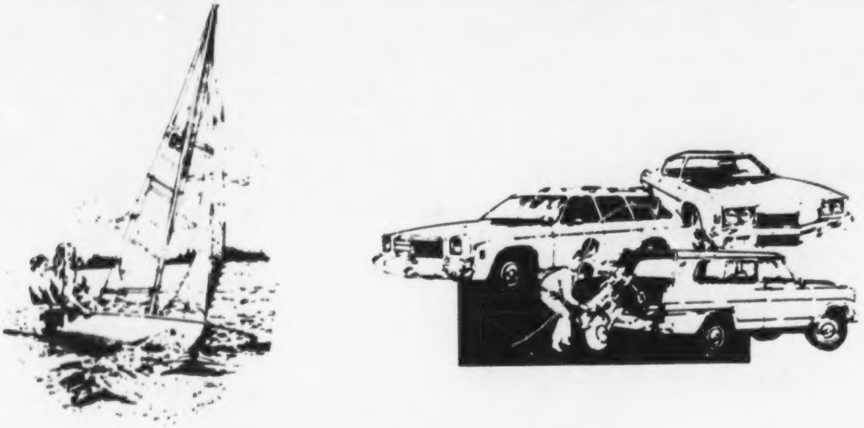
## TEACHER SUPPLEMENT #3

## WORD SEARCH ANSWER KEY

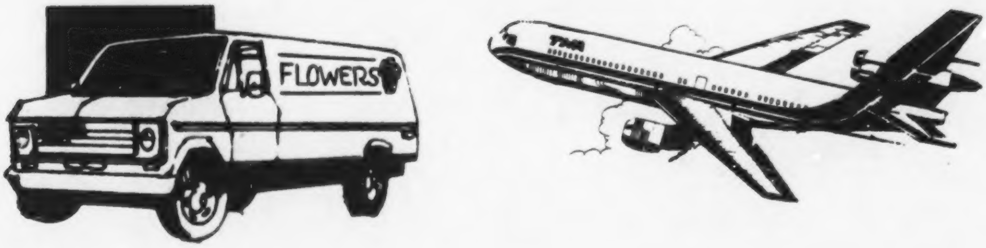


| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| J | E | T | T | L | E | Q | K | A | R | A | S | S | H | O | P | Y | X | D | X |
| Z | H | I | S | E | T | S | W | A | T | E | R | J | D | D | J | R | O | O | P |
| M | M | V | U | E | R | Q | C | G | M | O | W | E | D | P | L | O | A | T | A |
| Z | U | P | S | C | L | M | J | A | P | A | S | S | E | N | G | E | R | S | O |
| Z | S | N | U | Z | O | C | I | C | L | D | P | R | E | P | Q | H | G | R | M |
| T | T | S | C | C | Z | N | I | N | O | A | N | W | E | U | E | S | K | K | W |
| S | R | W | L | A | S | E | T | H | A | M | T | A | M | I | J | O | H | V | R |
| A | K | A | C | O | Y | H | S | R | E | L | M | O | L | C | A | R | G | O | L |
| I | C | V | N | O | D | I | I | P | O | V | S | E | R | R | I | A | K | K | P |
| R | N | A | H | S | N | A | N | G | A | L | L | S | R | S | X | W | X | U | D |
| P | P | C | C | Y | P | V | L | T | H | C | S | R | X | C | N | Q | O | T | E |
| L | I | Q | A | S | H | O | E | M | E | W | E | Y | N | B | I | S | H | I | P |
| A | P | V | J | L | U | S | R | Y | O | R | A | O | S | K | L | A | J | M | O |
| N | E | R | X | A | K | M | H | T | O | D | M | Y | H | T | Y | I | L | M | C |
| E | L | O | W | J | C | R | E | W | A | R | E | O | A | Y | E | D | A | J | Q |
| C | I | C | K | G | A | D | W | R | N | T | F | C | D | H | T | M | Y | Y | G |
| O | N | K | I | U | S | E | F | L | S | X | I | P | Q | A | N | S | S | P | V |
| R | E | E | E | R | X | N | A | Y | D | O | A | O | K | O | L | U | L | C | Q |
| U | C | T | Y | Q | A | C | D | N | X | N | K | Y | N | I | Z | G | F | E | F |

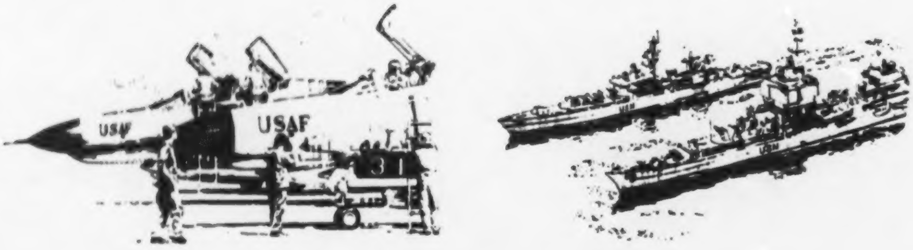
# Purposes of Transportation



For Personal Benefit

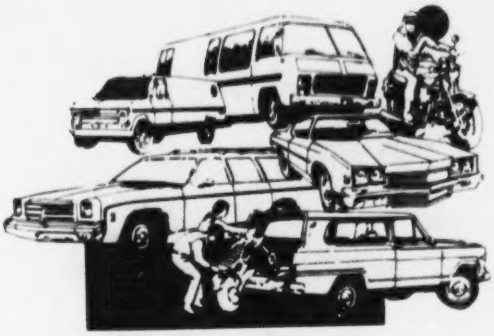

FLOWERS
TWA

For Commercial Gain

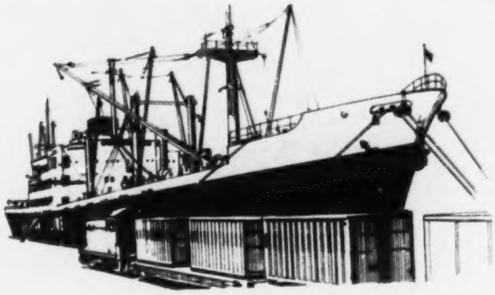

USAF
USAF
31

For Government Service or Defense

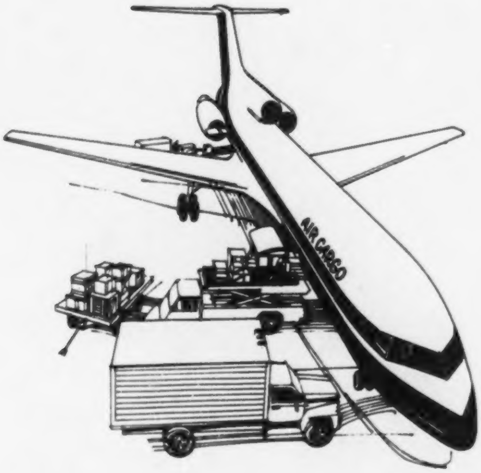
# Basic Modes of Transportation



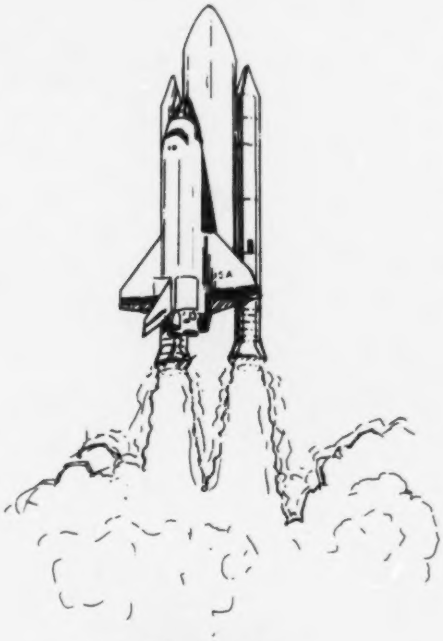
Land



Water



Air



Space

## TRANSPORTATION SYSTEMS
## UNIT E-4

## INFORMATION SHEET

I. **Terms and definitions**

A. Cargo (freight) — Solid, liquid, or gaseous material being moved from one place to another

B. Containerization — The use of containers in intermodal transportation

C. Intermodal transportation — Using more than one mode to transport passengers or cargo

Examples: Using a taxi to get to the airport so you can fly to another state, using trucks to haul cargo to a ship that will then haul the cargo to another country

D. On-site transportation — Moving people and/or materials over short distances within one particular area or building

E. Passengers — People who are being transported from place to place

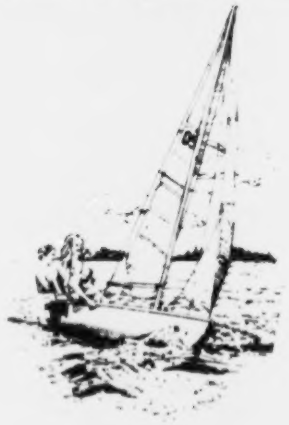
F. Terminals — The beginning and ending points for loading and unloading passengers and cargo

G. Transportation — The movement of people and material

II. **Purposes of transportation**

A. For personal benefit

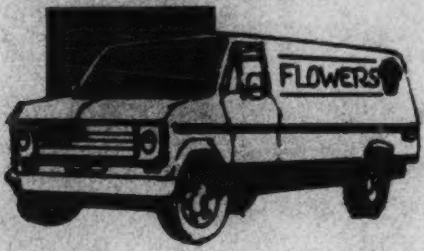
Examples: Driving the family car to and from the supermarket, sailing for pleasure, bicycling for exercise



## INFORMATION SHEET

B. For commercial (monetary) gain

Examples: Trucking companies, taxis, cargo ships, United Parcel Service, air express companies, airlines



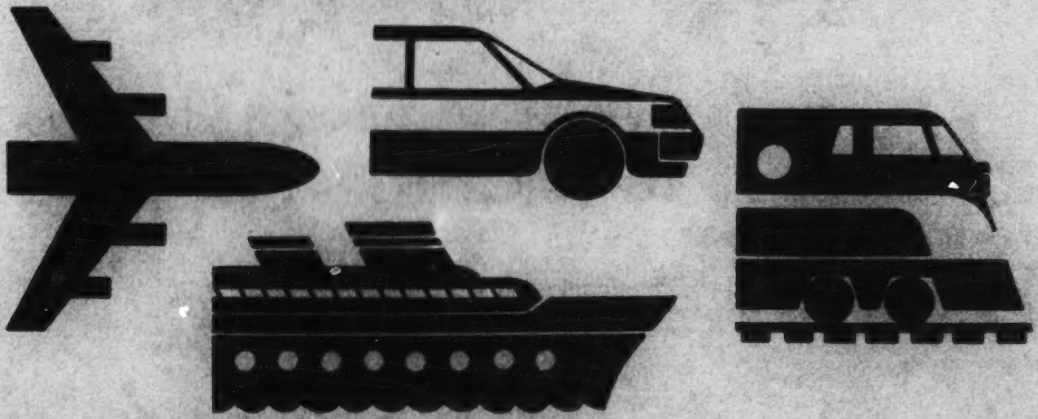
C. For government service or defense

Examples: City mass-transit buses, city garbage trucks, U.S. Postal Service, U.S. Naval Ships, U.S. Air Force cargo planes

### III. Components of a transportation system

A. Vehicle — Carries the cargo or passengers

Examples: Automobile, airplane, ship, train, space capsule



## INFORMATION SHEET

B. Control system — Keeps the vehicle traveling at the proper speed and direction

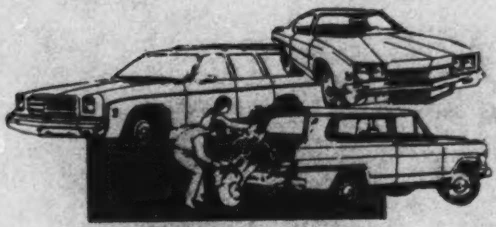
Examples: Steering wheel, rudder, brake

C. Power plant — Moves the vehicle

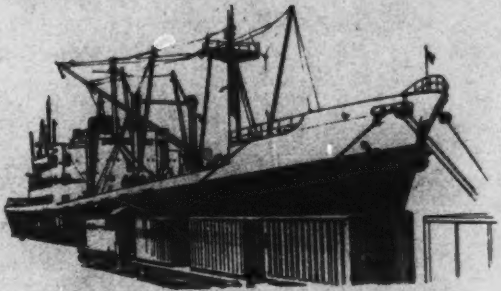
Examples: Engines and fuel

D. Mode or medium — Pathway that suspends or guides the vehicle

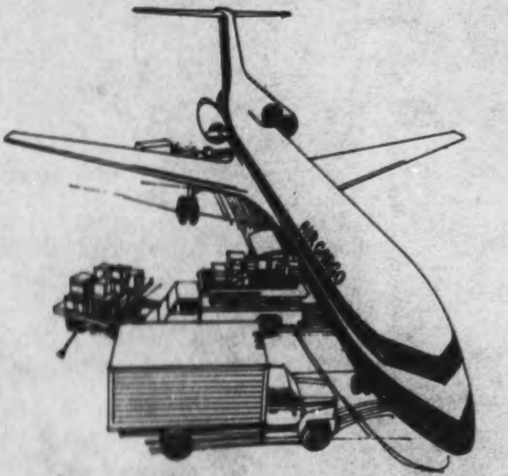
IV. **Basic modes of transportation**



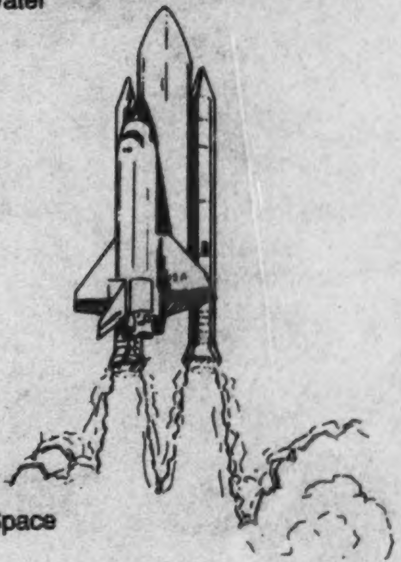
A. Land



B. Water



C. Air



D. Space

V. **Highway transportation**

A. Is a system of moving people and materials through a network of roads and highways.

B. Vehicles used on roads and highways include bicycles, motorcycles, cars, buses, and trucks.

## INFORMATION SHEET

C. Vehicles are independently controlled on the highway by the driver.

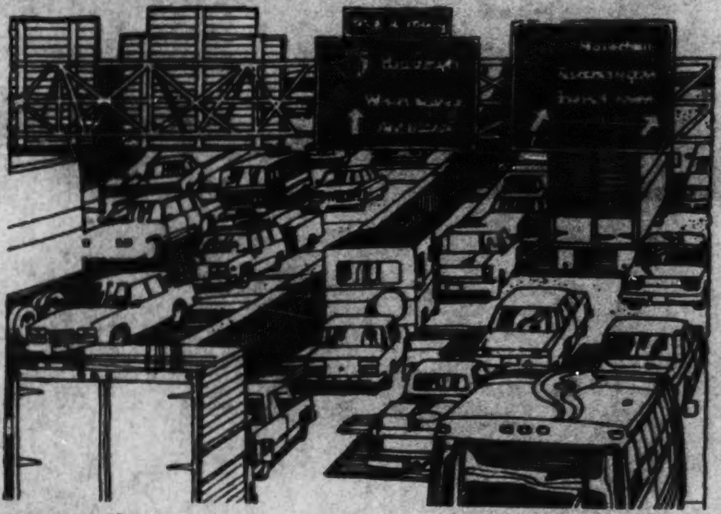
D. Highways are used for personal, commercial, and government transportation.

E. Commercial passenger service includes taxi and limousine service, local and regional bus lines, and large inter-city bus lines.

F. Commercial freight service includes trucks and large tractor-trailers such as tankers, refrigerated vans, and flatbed trailers.

G. Highways form a network of local, state, and interstate roads which connect the nation.

H. Road signs, symbols, and maps help to direct traffic and communicate information about highway routes.



**VI. Railway transportation**

A. Is a system of moving people and materials in vehicles that run on rails.

(NOTE: More rail transportation is used for moving materials than people because it is relatively slow.)

B. Rails may be above, below, or at ground level.

1. Above — Monorails, elevated railroads
2. Below — Subways
3. Ground level — Standard trains

## INFORMATION SHEET

C. The basic types of vehicles used on railroads are engines and railroad cars such as boxcars, flatcars, and hoppers.

D. Rail transportation is primarily used for commercial transportation.

E. Commercial passenger lines include AMTRAK and rapid transit trains.

F. Commercial freight lines include B & O, Santa Fe, and Union Pacific.

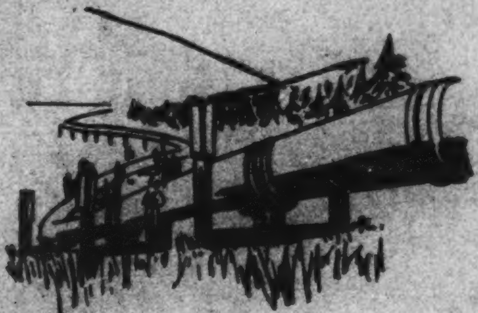
VII. **Pipeline transportation**

A. Move many types of materials through metal or plastic pipes depending on type of material and distance required.

B. Common materials transported through pipelines include oil, water, natural gas, waste materials, and minerals (mixed with water into slurry form).

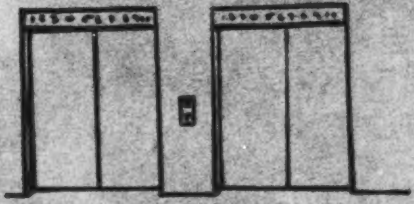
C. Pipelines may be underground or aboveground.

D. The most famous oil pipeline is the Trans-Alaska pipeline which began construction in 1973.

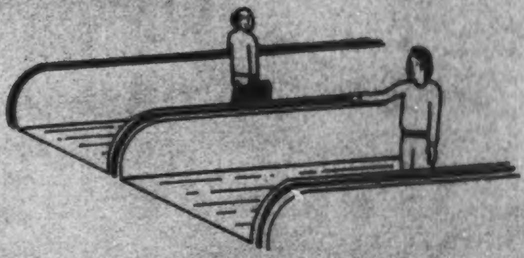


VIII. **Types of on-site transportation**

A. People moving — Movement of individuals inside the building using escalators, elevators, and moving sidewalks



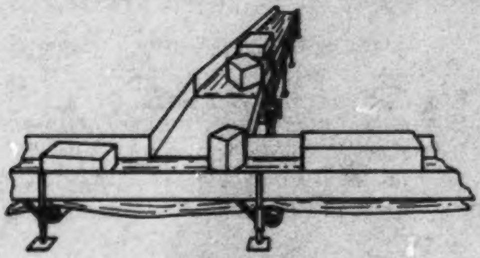
Elevator



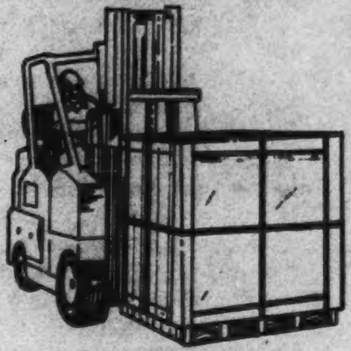
Moving Sidewalk

## INFORMATION SHEET

B. Materials handling — Movement of raw and finished products inside the building using conveyors, cranes and hoists, industrial trucks, and fork lifts



Conveyor



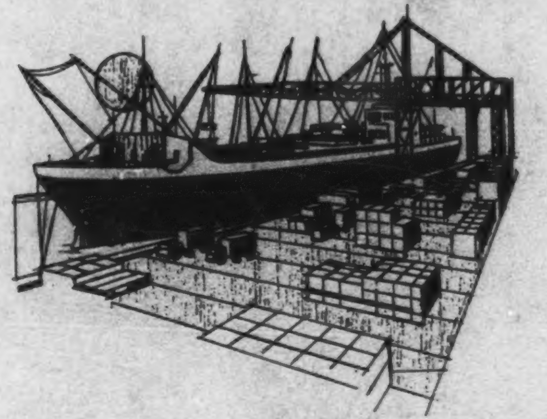
Fork Lift

IX. **Water transportation**

A. Is a system of moving people and materials in vessels through the water.

B. The basic types of vessels include

1. Ships — General cargo ships, tankers, containerships, cruise ships
2. Barges — Usually flat bottomed for transporting cargo; usually propelled by towing
3. Tugboats — Used for pushing and pulling ships and barges



## INFORMATION SHEET

C. Water transportation is used for personal, commercial, and government transportation.

   1. Personal transportation includes the use of boats and ships for travel and recreation.

      Examples: Skiing, fishing, sailing

   2. Commercial transportation includes ocean liners for transporting people on cruises as well as cargo liners or freighters that transport cargo on regular schedules and tramps that do not operate on a fixed sailing schedule.

   3. Government transportation includes the many vessels used by the military for national defense and service such as battleships, aircraft carriers, submarines, and patrol boats.

D. Bodies of water include lakes, rivers, seas, and oceans.

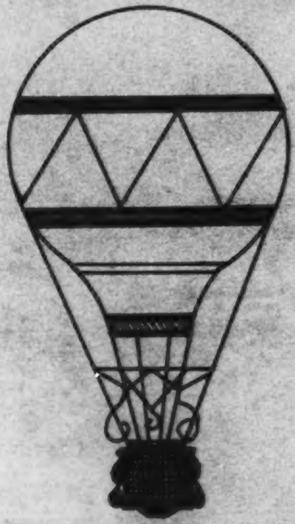
X. **Air transportation**

A. Is a system of moving people and materials in vehicles (aircraft) through the air.

(NOTE: More air transportation is used for moving people than freight because it is expensive.)

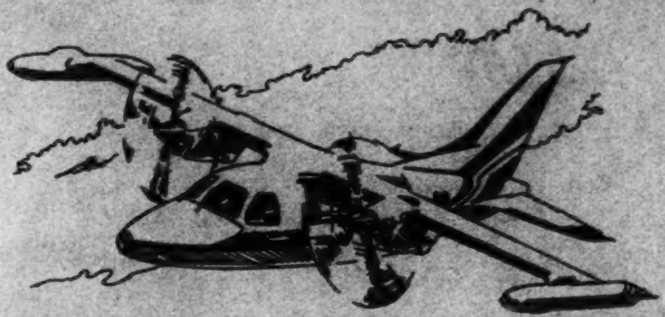
B. The basic types of vehicles used include

   1. Lighter-than-air craft — Hot air balloons, dirigibles, and blimps



## INFORMATION SHEET

2. Heavier-than-air craft — Airplanes, jet planes, gliders, helicopters



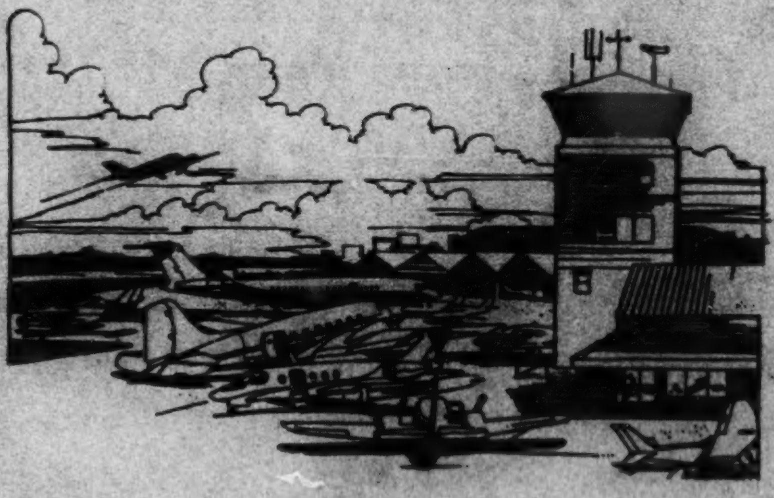
C. Air transportation is used for personal, commercial, and government transportation.

1. General aircraft are the smaller planes that carry fewer people and less cargo for personal transportation and business purposes.

2. Commercial aircraft are airplanes that carry passengers, mail, and cargo over the air routes.

3. Military aircraft are planes designed for specific military use, such as fighter planes, bombers, and cargo planes.

D. Air transportation is supported by airports that monitor flights and help to board passengers and cargo.



## INFORMATION SHEET

XI. **Space transportation**

A. Is a system of transportation for moving people and materials in vehicles (spacecraft) into outer space (outside the earth's atmosphere).

B. Use rocket engines that carry their own fuel and oxygen supplies.

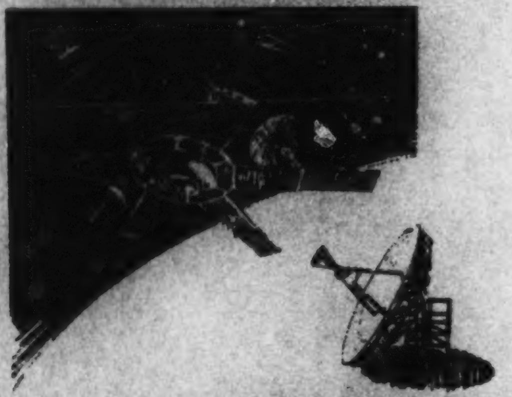
C. Use large launch vehicles to place spacecraft into orbit.

D. Space transportation is primarily used by the federal government for conducting experiments and exploring space. Space vehicles may be hired by commercial firms to place communication satellites in orbit.

E. Spacecraft are classified as manned or unmanned.

1. The first man-made satellite was put into orbit on October 4, 1957 by the U.S.S.R. It was called Sputnik.

2. Unmanned space vehicles are used for communication, weather forecasting, and military reconnaissance.



3. The first person in space was Russian cosmonaut Yuri Gagarin on April 12, 1961. He orbited the earth one time.

4. The United States followed closely after this with manned flights by American astronauts Alan Shepard, Virgil Grissom, and John Glenn.

## TRANSPORTATION SYSTEMS
## UNIT E-4

### ASSIGNMENT SHEET #1—SOLVE GAS MILEAGE PROBLEMS

Name ______________________ Overall Rating __________

| EVALUATION CRITERIA | RATING |
|---|---|
| Answers are correct | ______ |
| Assignment is neat and completed on time | ______ |

Directions: Solve the following problems using this formula:

$$\text{Miles Per Gallon (MPG)} = \frac{\text{Miles}}{\text{Gallons}}$$

1. Miss Jones drove home from college and used 7 gallons of gasoline. Her home is 200 miles from college. What was her MPG?

   MPG = ______________________

2. Joe drove 300 miles using 9 gallons of gas. What was his MPG?

   MPG = ______________________

3. Mr. Weaver used only 8 gallons to drive 322 miles. What was his MPG?

   MPG = ______________________

## ASSIGNMENT SHEET #1

4. Mrs. Baker drove 150 miles and used 16 gallons of gas. What was her MPG?

MPG = ______________________________

5. Sara drove 220 miles and used 11 gallons of gas. What was her MPG?

MPG = ______________________________

6. Discussion — What type of gas mileage (MPG) does your family vehicle get?

______________________________What type of vehicle is it? ______________________________

# TRANSPORTATION SYSTEMS
# UNIT E-4

## ASSIGNMENT SHEET #2—CLASSIFY CARGO AND SERVICES TRANSPORTED TO YOUR COMMUNITY

Name ______________________________ Overall Rating ______________

| EVALUATION CRITERIA | RATING |
|---|---|
| Answers are appropriate | _____ |
| Assignment is neat and completed on time | _____ |

Directions: How are the following items transported to your community?

| Cargo and Services | Transportation Mode and Vehicles |
|---|---|
| 1. Dairy products (milk, cheese, etc.) | |
| 2. Produce (lettuce, apples, etc.) | |
| 3. Clothing (shirts, coats, etc.) | |
| 4. Construction materials (lumber, bricks, gravel, etc.) | |
| 5. Printed materials (newspapers, books, magazines, etc.) | |
| 6. Mail (U.S., UPS, express) | |
| 7. Radio, TV communication | |
| 8. Raw materials for local industries | |
| 9. Gasoline | |
| 10. Tourists or visitors | |

## TRANSPORTATION SYSTEMS
## UNIT E-4

## ASSIGNMENT SHEET #3—DESIGN AND BUILD A MODEL TRANSPORTATION VEHICLE OR SYSTEM

Name ______________________________ Overall Rating ______________

| EVALUATION CRITERIA | RATING |
|---|---|
| Engineering design quality | ______ |
| Neatness | ______ |
| Operation | ______ |

Directions: Use materials provided by instructor to design and build a model transportation vehicle or system.

Examples:

- Model rocket
- Glider
- Airplane
- Helicopter
- Boat
- Submarine
- Train
- Car operated by radio, rubber band, or solar cell
- Conveyor system
- Pipeline system
- Space station or rover

## TRANSPORTATION SYSTEMS
## UNIT E-4

## ANSWERS TO ASSIGNMENT SHEETS

**Assignment Sheet #1**

1. 26.67 MPG
2. 33.34 MPG
3. 40.25 MPG
4. 9.375 MPG
5. 20 MPG
6. Evaluated to the satisfaction of the instructor

**Assignment Sheet #2 and #3**—Evaluated according to the stated criteria

# TRANSPORTATION SYSTEMS
# UNIT E-4

## TEST

Name ______________________________ Score ____________________

1. Match the terms on the right with the correct definitions.

______a. The use of containers in intermodal transportation

______b. People who are being transported from place to place

______c. Solid, liquid, or gaseous material being moved from one place to another

______d. The movement of people and material

______e. The beginning and ending points for loading and unloading passengers and cargo

1. Cargo
2. Containerization
3. Intermodal transportation
4. On-site transportation
5. Passengers
6. Terminals
7. Transportation

2. Select from the following list the correct purposes of transportation by placing an "X" in the appropriate blanks.

______a. For commercial gain

______b. For government service or defense

______c. For national communication

______d. For personal benefit

3. Match the components of a transportation system with the correct uses.

______a. Carries the cargo or passengers

______b. Keeps the vehicle traveling at the proper speed and direction

______c. Pathway that suspends or guides the vehicle

1. Control system
2. Mode or medium
3. Power plant
4. Vehicle

4. List three basic modes of transportation.

a. ________________________________________

b. ________________________________________

c. ________________________________________

## TEST

5. Complete the following statements concerning highway transportation by correctly filling in the blanks.

   a. Vehicles used on roads and highways include ________________________ and ________________________.

   b. Vehicles are independently controlled on the highway by the ________________________.

   c. Commercial passenger service includes ________________________.

   d. Commercial freight service includes ________________________.

6. Complete the following statements concerning railway transportation by circling the correct words.

   a. Is a system of moving people and materials in vehicles that run on (highways, rails).

   b. Monorails are (below, above) ground level.

   c. Rail transportation is primarily used for (personal, commercial) transportation.

   d. Commercial freight lines include (Santa Fe, AMTRAK).

7. Select true statements concerning pipeline transportation by placing a "T" or "F" next to the true or false statements.

   ______a. Pipelines are usually made of clay pipes.

   ______b. Oil, water, and natural gas are commonly transported through pipelines.

   ______c. Pipelines may be under or above ground.

8. Distinguish between types of on-site transportation by placing an "M" next to the materials-handling devices and a "P" next to the people-moving devices.

   ______a. Moving sidewalk

   ______b. Fork lift

   ______c. Conveyor

   ______d. Cranes and hoists

   ______e. Escalator

## TEST

9. Complete the following statements concerning water transportation by placing the correct number designations in the appropriate blanks.

______a. Usually flat bottomed for transporting cargo; usually propelled by towing.

1) Ships
2) Tugboats
3) Barges

______b. Used for pushing and pulling other vessels.

1) Ships
2) Tugboats
3) Barges

______c. This transportation includes cruise ships, freighters, and tramps.

1) Personal
2) Government
3) Commercial

10. Select true statements concerning air transportation by placing a "T" or "F" next to the true or false statements.

______a. The basic types of vehicles used include hot air balloons, airplanes, gliders, and helicopters.

______b. Air transportation is primarily used for personal transportation.

______c. Military aircraft are planes designed for specific military use, such as fighter planes, bombers, and cargo planes.

______d. General aircraft are the larger planes that carry more people and cargo for personal transportation and business purposes.

11. Select true statements concerning space transportation by placing a "T" or "F" next to the true or false statements.

______a. Space transportation uses gasoline or jet engines to carry spacecraft.

______b. Space transportation is primarily used by the federal government for experiments and exploration.

______c. The first man-made satellite was put into orbit in 1957.

______d. The first person in space was an American named John Glenn.

## TEST

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

12. Solve gas mileage problems. (Assignment Sheet #1)

13. Classify cargo and services transported to your community. (Assignment Sheet #2)

14. Design and build a model transportation vehicle or system. (Assignment Sheet #3)

## TRANSPORTATION SYSTEMS
## UNIT E-4

## ANSWERS TO TEST

1. a. 2
   b. 5
   c. 1
   d. 7
   e. 6

2. a, b, d

3. a. 4
   b. 1
   c. 2

4. Any three of the following:

   a. Land
   b. Water
   c. Air
   d. Space

5. a. Any two: Bicycles, motorcycles, cars, buses, trucks, others
   b. Driver
   c. Any one: Taxis, limousines, buses
   c. Any one: Trucks, tankers, vans, trailers

6. a. Rails
   b. Above
   c. Commercial
   d. Santa Fe

7. a. F
   b. T
   c. T

8. a. P
   b. M
   c. M
   d. M
   e. P

## ANSWERS TO TEST

9. a. 3
   b. 2
   c. 3

10. a. T
    b. F
    c. T
    d. F

11. a. F
    b. T
    c. T
    d. F

12-14. Evaluated to the satisfaction of the instructor